

**Implementation of the Texas Natural Resource
Conservation Commission Standards
Via Permitting**

August 23, 1995

TABLE OF CONTENTS

	Page
INTRODUCTION	1
DETERMINATION OF WATER QUALITY USES AND CRITERIA	2
Designated and Presumed Uses	2
Classified Waters	2
Unclassified Waters	2
Assessment and Review of Uses	4
EVALUATION OF WATER QUALITY IMPACTS	6
General	6
Eastern and Southern Portion of the State	7
Minimum and Seasonal Criteria	8
Other TNRCC Rules	8
ANTIDEGRADATION	9
Policy	9
Protection of Uses	9
High Quality Waters	9
Outstanding Waters	10
Review and Public Notice	10
TOXICS	11
General Provisions	11
Specific Numerical Criteria	11
Deriving Permit Limits for Aquatic Life Protection	13

TABLE OF CONTENTS (Continued)

	Page
Derivation of Permit Limits For Aquatic Life Protection	13
Correction for Background Concentrations of Pollutants	19
Definitions	19
Reliable Data	19
Procedure	21
Once-Through Cooling Water Discharges	22
Collection of Site-Specific Data	23
Partition Coefficient	24
Hardness and TSS	25
Silver Translator (Freshwater) for Calculating Permit Limits	25
Calculation of Chromium Permit Limits	27
Calculation of Total Dissolved Solids Permit Limits	28
Establishing Permit Limits for Toxic Materials for Which There are No Texas Surface Water Quality Standards	33
Deriving Permit Limits For Human Health Protection	34
Derivation of Permit Limits For Human Health Protection	35
Calculation of Dioxin/Furan Permit Limits	36
Establishing Permit Limits	37
Application Screening	37
Analytical Procedures	38
Defining Permit Limits	39
Alternate Analytical Test Methods	39
Total Toxicity Testing (Biomonitoring)	40
Chronic and 48-Hour Whole Effluent Toxicity Testing (Biomonitoring)	40
100% End-of-Pipe Acute Toxicity Testing	48
Test Substitution	50
Toxicity Attributable to Dissolved Salts	50
100% End-of-Pipe Acute Tests	51

TABLE OF CONTENTS (Continued)

	Page
48-Hour Acute and Chronic Tests	52
Freshwater Toxicity Attributable to Ammonia	55
Toxicity Attributed to Diazinon	55
Defining Critical Conditions and Mixing Zones	56
Mixing Zones and Critical Conditions for Aquatic Life Protection	57
Mixing Zones and Critical Conditions for Human Health Protection	59
Harmonic Mean Flow	60
SITE-SPECIFIC STANDARDS AND VARIANCES	60
General	60
Site-Specific Standards for Aquatic Life Use	62
General Procedure	62
Use-Attainability Analysis for Typical Sites	63
Site Complications Requiring Additional Justification	65
Site-Specific Numeric Aquatic Life Standards	65
Site-Specific Total Toxicity Standards	69
 Table 1. Background Concentrations	 72
Table 2. Aquatic Life Subcategories	73
Table 3. Critical low-flow values for dissolved oxygen for the eastern and southern Texas ecoregions as described in 30 TAC § 307.7(b)(3)(A)(ii)	74
Table 4. Linear Partition Coefficients for Priority Metals in Streams and Lakes	75

TABLE OF CONTENTS (Continued)

Page

Table 5.	Linear Partition Coefficients for Some Priority Metals in Estuarine Systems	76
Table 6.	Segment Specific Values for TSS, Total Hardness, and pH	77
Table 7.	TNRCC Minimum Analytical Levels for Application Screening	92
Table 8.	1995 Analytical Methods for the Determination of Pollutants Regulated by 30 TAC, Chapter 307, Section 307.6	97
Figure 1.	Map depicting the area of the state where the intermediate aquatic life use presumption applies (Area A), and the area of the state where adjustments of the dissolved oxygen criteria apply (Areas A + B)	3
Figure 2.	Protocol for the Inclusion of Background Concentrations in Establishing Permit Limits	20
Figure 3.	Establishing Permit Limits for Total Dissolved Solids	31
Figure 4.	Biomonitoring Frequencies for Domestic Majors or Minors with Pretreatment Programs	43
Figure 5.	Biomonitoring Frequency for Industrial Permits	43
Figure 6.	Procedure for Exemption from Total Toxicity Requirements Because of Dissolved Salts	54

IMPLEMENTATION OF THE TEXAS NATURAL RESOURCE CONSERVATION COMMISSION STANDARDS VIA PERMITTING

INTRODUCTION

The Texas Natural Resource Conservation Commission (TNRCC) adopted revisions to the Texas Surface Water Quality Standards (TSWQS) on June 14, 1995 as Title 30 Texas Administrative Code (TAC) Chapter 307. The TSWQS became effective on July 13, 1995. The TNRCC is charged with the responsibility of maintaining and enhancing the waters in the state through the permit process. The purpose of this document is to provide the regulated community, general public, and other interested parties with guidance and explanation of the general, as well as the technical procedures used by the Office of Water Resource Management in implementing the TSWQS into TNRCC wastewater discharge permits. This document will be updated when necessary to reflect new TSWQS and to document policy and procedural changes.

This document is referenced as Series 23 in the agency's Continuing Planning Process (CPP). The CPP is a document which describes in detail the State's water quality management program. It provides the TNRCC's current policies and procedures to prevent, control and abate water pollution. The CPP's purpose is to demonstrate that the program requirements and methods employed by the Commission will protect and maintain water quality for the benefit of the entire State. The State of Texas is responsible for managing its water quality program to implement the processes specified in the CPP (40 Code of Federal Regulations § 130.5 (b)).

Although all applications for permits to discharge wastewaters are considered individually, the TNRCC believes that a consistent approach to application review is important. A permit applicant may provide information throughout the technical review period to assist the TNRCC staff in the site-specific assessment and draft permit development. All preliminary determinations by the TNRCC staff in the development of a permit (e.g., instream uses, impact analysis, antidegradation, effluent limits, and all other specifications of the permit) are subject to additional review and revision through the public hearing process.

DETERMINATION OF WATER QUALITY USES AND CRITERIA

Designated and Presumed Uses

Classified Waters

The designated uses and associated criteria for classified segments in 30 TAC § 307.10 Appendix A will normally be used in permit evaluations. Site-specific 7Q2 (seven-day, two-year low flow) values unique to a discharge location within a segment may be used in lieu of published segment 7Q2 flows.

Unclassified Waters

Unclassified waters are those smaller water bodies which are not designated as segments with specific uses and criteria in Appendix A or D of 30 TAC § 307.10 of the TSWQS. 30 TAC § 307.4 (h)(1) states that unclassified waters which include perennial streams, rivers, lakes, bays, estuaries, and other appropriate perennial waters will be presumed to have a high aquatic life use and corresponding dissolved oxygen criteria (see Table 2) except for perennial streams and rivers in the northeast and southeast portion of the state. The northeast and southeast portion of the state is that area of the state east of a line defined by Interstate Highway 35 and 35W from the Red River southward to the Williamson County and Travis County line and then northward and eastward of the Colorado River Basin divide to the Texas coast (see Figure 1, area A). Those unclassified perennial streams and rivers located in this area will be presumed to have an intermediate aquatic life use and corresponding dissolved oxygen criteria (see Table 2). Higher uses will be maintained where they are attainable.

Intermittent streams are defined as having a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 flow less than 0.1 cfs is considered intermittent. According to 30 TAC § 307.4 (h)(2), intermittent, unclassified streams which are not specifically listed in Appendix A or D of 30 TAC § 307.10 will maintain a 24-hour mean dissolved oxygen concentration of 2.0 mg/L, and an absolute minimum dissolved oxygen concentration will be 1.5 mg/L. For intermittent streams with seasonal aquatic life uses, dissolved oxygen concentrations commensurate with the aquatic life uses will be maintained during the seasons in which the aquatic life uses occur.

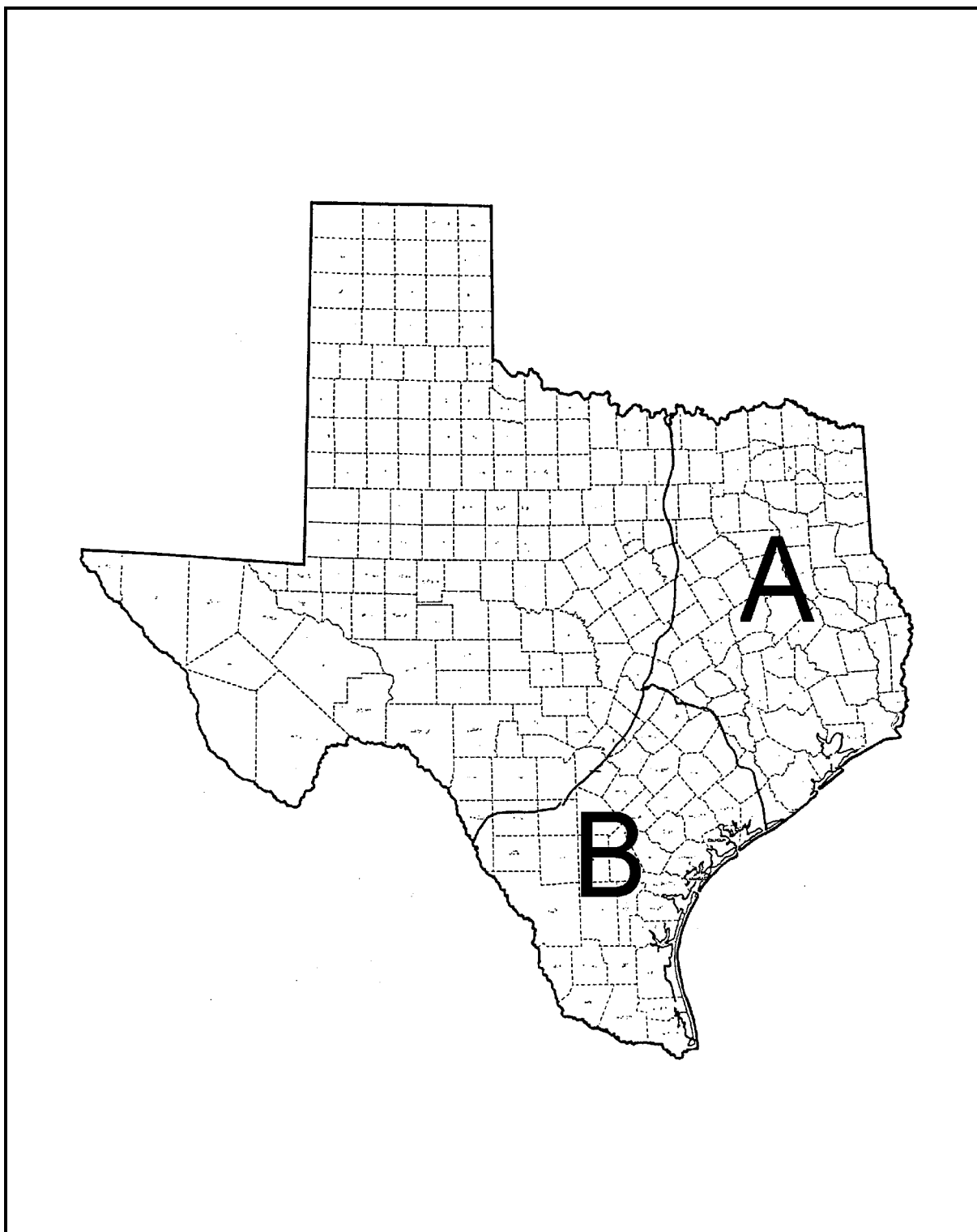


Figure 1: Map depicting the area of the state where the intermediate aquatic life use presumption applies (Area A), and the area of the state where adjustments of the dissolved oxygen criteria apply (Areas A + B).

Unclassified intermittent streams with significant aquatic life uses created by perennial pools are presumed to have a limited aquatic life use and corresponding dissolved oxygen criteria (see Table 2). Higher uses will be maintained where they are attainable.

At this time, the determination of what constitutes a seasonal aquatic life use, a significant aquatic life use, and perennial pool designation is done on a case-by-case basis using available data and best professional judgment. TNRCC will continue to develop improved procedures to address the issues of seasonal aquatic life use, significant aquatic life use, and perennial pools during the next three years.

The applicability of the TSWQS and the concomitant aquatic life use designation for playa lakes is discussed in the Playa Lake Policy Statement that was signed by the TNRCC Executive Director on April 10, 1995.

In addition to aquatic life uses, unclassified waters can be assigned uses for contact or noncontact recreation and domestic water supply. Basic uses such as navigation, agricultural water supply, and industrial water supply will normally be assumed for all waters. Fecal coliform criteria consistent with a contact recreation use will also be assumed for all unclassified waters.

Assessment and Review of Uses

Uses and associated criteria for classified waters will normally be assumed as stated in 30 TAC § 307.10 Appendices A and D. Implementation of 30 TAC § 307.4(h) and 307.4(k) (concerning dissolved oxygen and aquatic life uses and assessment of unclassified waters) requires that appropriate uses be determined for unclassified waters that are affected by permit renewals, permit amendments, and new permit applications.

All permit applicants will be requested to provide information about the receiving water as part of the permit application. The assigned use and appropriate criteria will be used in water quality simulations to determine appropriate effluent limits needed to protect the uses. The criteria for assessing aquatic life use categories are based on categorical characteristics in 30 TAC § 307.7(b)(3)(A) (see Table 2).

The determination of general stream type - whether perennial, intermittent, or intermittent with perennial pools - is of major importance in assigning uses to unclassified streams. Permittees with discharges to small unclassified streams are encouraged to develop and submit additional documentation concerning the general stream type and stream flows at their discharge site.

TNRCC staff will evaluate available information and determine appropriate uses and criteria for each permit action for discharge into waters in the state. For sites where

available information indicates that the presumed uses and criteria in the standards for unclassified streams may be inappropriate, additional data may be obtained by TNRCC or the applicant in the form of a receiving water assessment. Procedures for collecting the physical and biological data for receiving water assessments are described in the "Texas Water Commission Permit Site Assessment Instruction Manual, December 1988." The evaluation of aquatic life uses based on site assessment data is described in "Criteria for Assessing Aquatic Life Uses, August 1988." Both of these documents are available upon request from the Standards Team of the Water Planning and Assessment Division of the TNRCC.

TNRCC staff may review the preliminary determinations of use and the criteria associated with those uses throughout the permit application review if new information becomes available and/or if there are errors in the evaluations. Notice to the applicant of preliminary use determinations that appear to be appropriate will be expeditious, and the applicant will be given opportunity to discuss the preliminary determination of use and provide additional information. Public notices concerning the proposed draft permit will indicate any preliminary additional uses assigned to the unclassified receiving waters.

Considerations for determining the aquatic life use categories include the following:

1. Aquatic life use determinations will be estimated for the same set of hydrologic conditions (normally low flow or critical conditions) that are used to analyze the impact of permitted discharges. These determinations may consider seasonal uses and associated seasonal hydrologic conditions other than critical conditions. Permit limits for pertinent parameters will be established as necessary to protect seasonal uses in both intermittent and perennial streams.
2. Primary assessments of physical, hydrologic, chemical, and biological conditions will emphasize the area upstream of and/or unaffected by an existing discharge. Differences in stream morphometry downstream of the discharge will also be taken into account in determining appropriate aquatic life uses.
3. Site-specific modification of the aquatic life criteria in 30 TAC § 307.7(b)(3)(A) (see Table 2) may be considered when sufficient information is available to justify such modifications. Site-specific modifications will be evaluated in accordance with procedures for regional development of criteria or other procedures approved by the TNRCC staff (see the section of this document titled, "Site-Specific Standards and Variances").
4. The aquatic life attributes in 30 TAC § 307.7(b)(3)(A) (see Table 2) will be used to assign aquatic life use categories. No single attribute will override the aggregate consideration of all attributes.

5. The attribute characteristics in 30 TAC § 307.7(b)(3)(A) (see Table 2) will be further clarified, modified, and "calibrated" as more region-specific data becomes available.
6. The instream uses assigned to unclassified waters at a particular discharge site are not automatically assumed to be appropriate for other discharge sites in the same water body.
7. Unclassified perennial waters with sufficient information obtained under these procedures will be considered for classification during the triennial review of the standards.

When attainable aquatic life use for a particular unclassified waterbody might be lower than the presumed aquatic life uses, a use-attainability analysis is conducted. See the later section entitled "Site-Specific Standards for Aquatic Life Use".

EVALUATION OF WATER QUALITY IMPACTS

General

New permit applications, permit renewals, and permit amendments will be reviewed to ensure that permitted effluent limits will maintain instream criteria for dissolved oxygen and other parameters such as fecal coliform bacteria, phosphorus, nitrogen, turbidity, dissolved solids, temperature, and toxic materials. Assessment of appropriate uses and criteria for unclassified waters will be conducted in accordance with the previous sections.

This evaluation will also include a determination of any anticipated impacts from ambient or baseline conditions, in order to implement antidegradation procedures (see following section). Conditions for the evaluation of impacts will be commensurate with ambient or baseline conditions. Waste load evaluation recommendations will normally be incorporated into permit limits for discharges into segments with completed waste load evaluations. For receiving waters without specific waste load evaluations, impacts will be evaluated using the TNRCC adaptation of the Streeter-Phelps dissolved oxygen deficit model or other appropriate analyses. Additionally, during development of an individual permit, TNRCC staff may use information gathered for development of a waste load evaluation. The model structure and assumptions for stream geometry, flow characteristics, and reaction rate coefficients are available upon request. Site-specific information supplied by permit applicants, TNRCC Region staff, and/or river authorities/local governments will be incorporated into modeling assumptions when appropriate. The primary evaluation of instream dissolved oxygen is conducted at 7Q2 flows (measured at United States Geological Survey, USGS, gauge stations or estimated) and maximum summer temperatures (initially assumed to be 30°C unless 7Q2 flows reliably occur only at other temperatures), and the principal criterion of concern is the 24-hour dissolved oxygen mean

at these critical conditions. Evaluations of the water quality impact of permitted discharges and the permit effluent limitations based upon these evaluations are subject to additional review and revision throughout any permit hearing process.

Eastern and Southern Portion of the State

As specified in 30 TAC § 307.7(b)(3)(A)(ii), unclassified streams, as well as those partially classified streams listed in Appendix D (of 30 TAC § 307.10), in the eastern and southern portion of the state may be evaluated for 24-hour dissolved oxygen attainment at stream flows greater than 7Q2 flows (see Table 3). The criteria in Table 3 apply to the portion of the state east of a line defined by Interstate Highway 35 and 35W from the Red River to the community of Moore in Frio County, and by U.S. Highway 57 from the community of Moore to the Rio Grande (see Figure 1, areas A + B). The headwater flows shown in Table 3 may be used to evaluate summertime 24-hour dissolved oxygen criteria (as given in Table 2) for a presumed or assigned aquatic life use. The flow values in Table 3 were derived from a multiple regression equation using data collected from the TNRCC least impacted stream study (Texas Aquatic Ecoregion Project). Results of this study indicate a strong dependent relationship for average summertime dissolved oxygen concentrations and several hydrologic and physical stream characteristics - particularly stream flow and bedslope (stream gradient). Stream flows and average dissolved oxygen concentrations were measured during steady-state conditions and bedslopes were estimated from 1:24,000 USGS topographical maps. Approximately 72% of the variation in observed average dissolved oxygen concentrations in these minimally impacted streams is explained by the regression equation. The regression equation is as follows:

$$\text{DO} = 7.088 + 0.551 \ln(Q + 0.01) + 0.686 \ln \text{Bd} - k$$

where:

DO = dissolved oxygen in mg/L

Q = flow in cfs

Bd = bedslope in m/km

k = 1.61 (constant for 50th percentile of tree canopy cover)

The coefficient of determination or r^2 , adjusted for degrees of freedom, for this equation is 0.72 ($p < 0.0001$). This equation may be used to calculate headwater flows for bedslopes within the range of 0.1 m/km to 2.4 m/km. For bedslopes less than or greater than this range, the corresponding flows given in Table 3 for the above bedslopes should be used. The headwater flows are calculated for dissolved oxygen concentrations of 0.5 mg/L greater than the criteria obtained from Table 2.

Bedslopes should be calculated from U.S.G.S. 1:24,000 topographic maps for the portion of stream from the first contour line that crosses the stream greater than one-half mile upstream of the point of discharge, to the first contour line that crosses the stream downstream beyond the estimated distance of discharge impact (see Table 1, Texas Water Commission Permit Site Assessment Instruction Manual, December, 1988). The actual stream bedslope is calculated by the following formula:

$$Bd = (E_u - E_d) / D$$

where:

Bd = bedslope in m/km

E_u = upstream elevation in meters

E_d = downstream elevation in meters

D = linear distance along the streambed between the two elevation contours in kilometers

(Note - the elevations and linear distance in the formula could be calculated in feet and then multiplied by 1,000 to convert to meters per kilometer)

Minimum and Seasonal Criteria

Instantaneous minimum dissolved oxygen criteria (from Table 2) and seasonal criteria will also be considered. The evaluation of permit limits for seasonal uses will generally use either a low flow frequency or a seasonal 7Q2 and associated temperatures to estimate critical low flow conditions in a particular month or season. Procedures for establishing mixing zones for dissolved oxygen considerations will be identical to the mixing zone procedures described later for toxics, in accordance with 30 TAC § 307.8 (b).

Other TNRCC Rules

In addition to effluent limits based on dissolved oxygen and other appropriate criteria, the draft permit will also include all treatment requirements of applicable TNRCC rules such as 30 TAC § 309 entitled "Effluent Limitations", 30 TAC § 311 entitled "Watershed Protection", 30 TAC § 313 entitled "Edwards Aquifer", and 30 TAC § 319 entitled "General Regulations Incorporated Into Permits".

ANTIDEGRADATION

Policy

The antidegradation policy affords three tiers of protection to the waters in the state. The first level stipulates that existing uses of the water body will be maintained and protected. The second level affords protection of actual water quality where the quality of waters exceed the typical range of fishable/swimmable criteria. The quality of these waters in the area impacted by the discharge outside the mixing zone can only be lowered if necessary for important social and economic development. The third level provides special protection to those high quality waters for which ordinary use classifications do not suffice, denoted as outstanding national resource waters (ONRW). The antidegradation policy and antidegradation implementation procedures are specified in 30 TAC § 307.5. The following section provides additional information for antidegradation implementation.

Protection of Uses

Applications for new permits and permit amendments which increase discharge loadings will be reviewed for compliance with the antidegradation policy. Existing uses and criteria for unclassified receiving waters will be established in accordance with the previous section on Assessment and Review of Uses. The TNRCC staff will then review available information on the receiving waters and discharge characteristics to ensure the maintenance of instream criteria which are essential to existing uses, as is required for the first tier of antidegradation protection. Dissolved oxygen and other parameters of particular concern for a specific receiving site - such as fecal coliform bacteria, phosphorus, nitrogen, turbidity, dissolved solids, temperature, and toxic materials - are also included in the evaluation. Protection of uses with respect to toxic materials is discussed in the following section on toxics.

High Quality Waters

The second tier of the antidegradation policy will be applied to high quality and exceptional quality waters, which are indicated by (1) existing or baseline uses of high or exceptional quality aquatic life and contact recreation, and (2) baseline water quality conditions which exceed criteria for high quality aquatic life use and contact recreation. Baseline water quality conditions are predicted on estimated conditions as of November 28, 1975, in accordance with EPA standards regulation 40 Code of Federal Regulations § 131. Baseline conditions will be estimated from existing conditions unless recent degradation in ambient water quality has occurred in the receiving waters. Baseline or existing water quality for parameters of concern will be determined through the same information sources and analogous procedures as described in the previous section on Assessment and

Review of Uses. The initial focus will again be on dissolved oxygen, but other parameters of concern at a particular discharge site - such as fecal coliform bacteria, phosphorus, nitrogen, turbidity, dissolved solids, temperature, and toxic materials - will also be considered.

The impact of a proposed discharge on baseline water quality will then be estimated for parameters of concern to determine if the anticipated result of a proposed discharge constitutes degradation. Evaluations of dissolved oxygen impacts will be conducted as previously described. Similar analyses may be conducted for other parameters of concern.

Outstanding Waters

The analysis of discharge permit impacts on Outstanding National Resource Waters will be conducted as above for High Quality Waters. ONRWs are defined in 30 TAC § 307.5 (b)(3) as high quality waters within or adjacent to national parks and wildlife refuges, state parks, wild and scenic rivers designated by law, and other designated areas of exceptional recreational or ecological significance. The quality of such waters will be maintained and protected. No increased point source loading which could cause degradation will be allowed into ONRWs. Currently, there are no designated ONRWs in Texas.

Review and Public Notice

If the antidegradation provisions in the standards have been addressed in an approved waste load evaluation, then a permit which is consistent with this evaluation will not be separately subjected to antidegradation procedures -- unless the discharge may cause impacts on the receiving water which were not addressed by the waste load evaluation.

Preliminary staff determinations concerning antidegradation may be subject to further review by agency staff throughout the permit application review period. Contact with the applicant regarding preliminary determinations will be done expeditiously. The applicant will be given an opportunity to discuss preliminary determinations of use and to provide additional information.

Public notices concerning the proposed permit or permit amendment will include any preliminary additional uses assigned to unclassified receiving waters. For exceptional quality and high quality receiving waters, the public notice will also indicate whether or not degradation is anticipated. Information in public notices concerning uses and antidegradation will be indicated as preliminary and is subject to additional review and revision prior to approval of the permit by the Commission. A summary of anticipated impacts and the criteria for preliminary determinations of whether degradation will occur will be publicly available in the permit file. When degradation of exceptional and high

quality waters is anticipated the Commission will consider arguments that the economic or social development resulting from the permit is sufficient to justify the degradation.

TOXICS

The TNRCC standards for toxic pollutants include general provisions, specific numerical criteria, and total toxicity limitations.

General Provisions

Water in the state shall not be acutely toxic. Although acute criteria may be exceeded in a zone of initial dilution (ZID), there shall be no lethality to aquatic organisms which move through the ZID. Water in the state shall not be chronically toxic except in mixing zones, below critical flow, and where there are no significant aquatic life uses. For discharges into intermittent streams, the TNRCC staff will prepare a permit that protects against acute toxicity at the point of discharge. For discharges that reach perennial waters within three miles, the permit will protect against chronic toxicity in any downstream perennial waters or enduring pools with significant aquatic life uses. Permits for discharges into classified and unclassified stream segments, will be designed to protect against chronic toxicity in waters with aquatic life uses.

Specific Numerical Criteria

The toxic numerical criteria for the protection of aquatic life (30 TAC § 307.6(c)) are expressed for freshwater acute, freshwater chronic, marine water acute, and marine water chronic conditions. The numerical criteria for the protection of human health (30 TAC § 307.6(d)) are expressed as receiving water concentrations to prevent contamination of drinking water, fish, and other aquatic life to ensure that they are safe for human consumption. The three categories of criteria given in the standards are: water and fish, freshwater fish only, and saltwater fish only. These standards apply whether or not they are addressed specifically in a wastewater discharge permit. For the TNRCC domestic wastewater permit program, when a permit applicant has treatment facilities with a permitted daily average flow equal to or greater than 1 MGD (million gallons per day) and/or administers a pretreatment program, the applicant will be required to submit effluent data as part of a permit application for those elements and compounds for which there are standards and which the TNRCC believes likely to be present in domestic effluent. Additionally, the TNRCC will address smaller facilities on a case-by-case basis when facility inspection or the TNRCC has documented the presence of toxic substances in the receiving water. Industrial permit applicants will also be required to submit analyses of

their effluent for those elements and compounds for which there are standards and which the TNRCC believes likely to be present in industrial effluent.

Deriving Permit Limits for Aquatic Life Protection

In order to determine the expected concentration of a toxic substance in a stream or river, the staff will use the general approach found in the EPA publication entitled "Technical Support Document for Water Quality-based Toxics Control, (EPA/505/2-90-001)". The staff will use the data from the nearest gauging station or available site-specific information to assess critical low flow conditions. The staff will apply acute criteria for effluent discharging into intermittent streams, and will assume a critical low flow of 0.0 cfs. Discharges into intermittent streams which flow into perennial waters within a moderate distance downstream (normally 3 miles) will be analyzed using acute and chronic criteria and the critical low flow of the perennial waters to determine if more stringent requirements are needed to protect those perennial waters. Permit limits will be developed to ensure that intermittent streams with sufficient flow and other characteristics to develop significant seasonal aquatic life uses will meet chronic toxic criteria during the seasons and typical flow conditions in which these uses occur.

The staff will apply chronic criteria at critical mixing conditions for other water bodies with aquatic life uses (lakes, bays, estuaries, tidal rivers) unless acute criteria are more protective. For certain substances, water quality standards are a function of one or more of the following receiving water parameters: total suspended solids (TSS), pH, hardness, and chlorides. Fifteenth percentile (15th) values of segment pH, TSS, and hardness data are used to define critical conditions (see Table 6). Basin values will be used when there is insufficient segment data. The fiftieth (50th) percentile value from basin chloride data will be used to implement the freshwater silver standard for aquatic life protection. The staff will normally access the TNRCC's surface water quality monitoring (SWQM) data base for this information, although the permittee may submit site-specific data. The procedures to collect site-specific data for hardness, TSS, and partition coefficients are outlined in the section of this document titled, "Collection of Site-Specific Data". The numerical standards for specific toxic substances apply to total recoverable concentrations, except for standards for designated metals. For these metals, the numerical standards apply to dissolved concentrations. In order to determine instream compliance with the numerical standards for dissolved concentrations, TNRCC staff will use the partition coefficients in accordance with Table 4 (streams and lakes) and Table 5 (estuarine systems), and/or site-specific data. Guidelines for developing a site-specific partition coefficient are given in the section of this document titled, "Collection of Site-Specific Data". The TNRCC will evaluate metals not included in these tables by assuming the dissolved concentration equals the total recoverable concentration unless sufficient additional information and data are presented which justify a different fraction of dissolved metal. TNRCC staff will calculate

permit limits required to maintain standards by comparing calculated limits with the effluent analysis. This process is described in the following sections.

Derivation of Permit Limits For Aquatic Life Protection

The first step in developing permit limits is to calculate a waste load allocation from the acute criteria (WLA_a) and a waste load allocation from the chronic criteria (WLA_c). The WLA equals the effluent concentration that will not cause an exceedance of instream criteria outside the mixing zone. This requires use of the appropriate mixing zone concept and/or 7Q2 flow as well as the bioavailable or available fraction of the pollutant. Complete mixing is assumed at the edge of the mixing zone (MZ), allowing calculation of the fraction of effluent at this location. For discharges to streams and rivers, only part of the 7Q2 stream flow (25%) will be used to calculate the dilution at the edge of the Zone of Initial Dilution (ZID). The proportion of effluent at the edge of the mixing zone will be used to calculate the WLA_c, and the dilution at the edge of the ZID will be used to calculate the WLA_a.

$$WLA_a = \frac{\text{Acute Criteria}}{(\text{Fraction Available})(\text{Fraction Effluent @ Edge of ZID})}$$

$$WLA_c = \frac{\text{Chronic Criteria}}{(\text{Fraction Available})(\text{Fraction Effluent @ Edge of MZ})}$$

For discharges to perennial freshwater streams and rivers and narrow tidal rivers (<400 feet across), the proportion of effluent used in each WLA is calculated as follows:

$$\text{Fraction Effluent @ Edge of MZ} = \frac{Q_E}{[Q_S + Q_E]}$$

$$\text{Fraction Effluent @ Edge of ZID} = \frac{Q_E}{[(Q_S)(.25) + Q_E]}$$

where, Q_S = 7Q2 stream flow
 Q_E = effluent flow,

For discharges to lakes, bays, and wide tidal rivers (≥ 400 feet across), the fraction of effluent used in each WLA will be that amount of effluent at the edge of the ZID or Mixing Zone as predicted by empirical models. A discussion of the mixing assumptions and exceptions and corresponding effluent fractions is given in the section of this document titled, "Defining Critical Conditions and Mixing Zones".

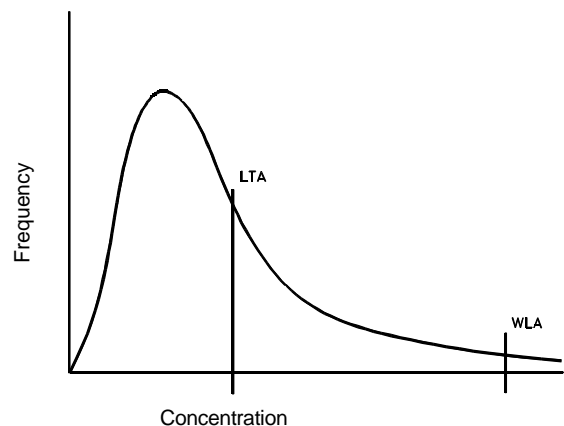
The effluent flow rate that is used for dilution calculations will be determined on a case-by-case basis. Domestic wastewater discharge assessments will generally be based upon the final daily average permitted flow. Industrial discharge assessment will generally be based upon the highest monthly average discharge of the preceding two year period. Other flows may be used for industrial dischargers (eg. 50th or 75th percentile flow as determined by self-reported data) if the highest monthly average discharge does not reflect normal operating conditions. The effluent flow used to calculate the WLA should also be used to calculate the final mass limits.

Once the WLAA and the WLAc are calculated, TNRCC determines the long-term average (LTA) of the treatment system performance (LTAA and LTAc) that is necessary to meet the respective WLA with a given probability. The TNRCC bases its calculation on a log-normal probability distribution that is known to describe treatment system performance. The graph displayed shows the general shape of a log-normal probability distribution. The LTAA and the LTAc are calculated with equations that describe this function.

The equations that are necessary to calculate the LTAA and the LTAc are shown below. While these exponential and logarithmic equations are quite complex, the important thing to recognize is that the equations are driven by the values that are assumed for n (averaging period), CV (coefficient of variation), and Z (probability distribution factor). The values that the TNRCC assumes for these variables are:

$n = 7$ (7-day average, for chronic criteria)
 $Z = 1.282$ (90% probability for discharges to freshwater streams, rivers, and narrow tidal rivers)

or



2.326 (99% probability for discharges to lakes, bays, estuaries,
or wide tidal rivers)
CV = 0.6

ACUTE	CHRONIC
$LTAA = \exp(u + 0.5s^2)$	$LTAc = \exp(u + 0.5s^2)$
$u = \ln WLAa - Zs$	$u = u_n - 0.5s^2 + 0.5s_n^2$
$s = [\ln (CV^2 + 1)]^{1/2}$	$u_n = \ln WLAc - Zs_n$
$s^2 = \ln (CV^2 + 1)$	$s_n = \{\ln [1 + (CV^2/n)]\}^{1/2}$
	$s_n^2 = \ln [1 + (CV^2/n)]$
	$s^2 = \ln (CV^2 + 1)$

A set of multiplying factors can be calculated by inserting the assumed values for n, CV, and Z and simplifying the equations. These factors can be used to calculate LTAs once the WLAs are determined, provided that the assumed values for n, CV, and Z are not changed.

Acute Long-term Average

$$s = [\ln (0.6^2 + 1)]^{1/2} = 0.555$$

At 99% probability, Z = 2.326, so

$$u = \ln WLAa - 2.326(0.555) = \ln WLAa - 1.291$$

$$LTAA = \exp[\ln WLA - 1.291 + 0.5(0.555)^2]$$

$$LTAA = \exp(\ln WLAa - 1.291 + 0.154)$$

$$LTAA = \exp(\ln WLAa - 1.137)$$

Since $e^{x-y} = e^x/e^y$,

$$LTAa = e^{\ln WLAa} / e^{1.137}$$

$$LTAa = WLAa / 3.11, \text{ or}$$

$$\mathbf{LTAa = 0.32 \times WLAa \text{ (99\% probability)}}$$

If probability is 90%, $Z = 1.282$, and

$$\mathbf{LTAa = 0.573 \times WLAa \text{ (90\% probability)}}$$

Chronic Long-term Average

$$u = \ln WLAc - Zs_n - 0.5s_n^2 + 0.5s_n^2$$

$$LTAc = \exp(\ln WLAc - Zs_n - 0.5s_n^2 + 0.5s_n^2 + 0.5s_n^2)$$

$$LTAc = \exp(\ln WLAc - Zs_n + 0.5s_n^2)$$

$$s_n = \{\ln [1 + (0.6^2/7)]\}^{1/2} = 0.224$$

$$s_n^2 = 0.050$$

At 99% probability, $Z = 2.326$, so

$$LTAc = \exp[\ln WLAc - 2.326(0.224) + 0.5(0.050)]$$

$$LTAc = \exp(\ln WLAc - 0.521 + 0.025)$$

$$LTAc = \exp(\ln WLAc - 0.496)$$

$$LTAc = e^{\ln WLAc} / e^{0.496}$$

$$LTAc = WLAc / 1.642 \text{ or}$$

$$\mathbf{LTAc = 0.61 \times WLAc \text{ (99\% probability)}}$$

If probability is 90%, $Z = 1.282$, so

$$\mathbf{LTAc = 0.770 \times WLAc \text{ (90\% probability)}}$$

The calculated values of LTAA and LTAC are compared. The smaller LTA will be limiting, so it will be used to calculate the daily average and daily maximum concentration limits (DLY AVG and DLY MAX, respectively) using the equations below.

The equations are still driven by the assumed values for Z (1.282 or 2.326), CV (0.6), and n, where n is now the number of sample events per month. For consistency the TNRCC assumes n = 12 even if the sampling frequency defined in the permit is not 3 per week.

DAILY AVERAGE	DAILY MAXIMUM
$DLY\ AVG = \exp(u_n + Zs_n)$	$DLY\ MAX = \exp(u + Zs)$
$u_n = u + [(s^2 - s_n^2)/2]$	$u = \ln LTA - 0.5s^2$
$u = \ln LTA - 0.5s^2$	$s^2 = \ln (CV^2 + 1)$
$s^2 = \ln (CV^2 + 1)$	$s = [\ln (CV^2 + 1)]^{1/2}$
$s_n^2 = \ln [1 + (CV^2/n)]$	
$s_n = \{\ln [1 + (CV^2/n)]\}^{1/2}$	

A set of multiplying factors can be calculated by inserting the assumed values for n, CV, and Z, and simplifying the equations. These factors can be used to calculate the daily average and the daily maximum concentration limits, provided that the assumed values for n, CV, and Z are not changed.

Daily Average Limit

$$s^2 = \ln (0.6^2 + 1) = 0.307$$

$$u = \ln LTA - 0.5(0.307)$$

$$u = \ln LTA - 0.154$$

$$s_n^2 = \ln [1 + (0.6^2/12)] = 0.030$$

$$s_n = 0.173$$

$$u_n = \ln LTA - 0.154 + [(0.307 - 0.030)/2]$$

$$u_n = \ln LTA - 0.154 + 0.139$$

$$u_n = \ln LTA - 0.015$$

At 99% probability, $Z = 2.326$, so

$$DLY\ AVG = \exp[\ln LTA - 0.015 + 2.326(0.173)]$$

$$DLY\ AVG = \exp(\ln LTA - 0.015 + 0.402)$$

$$DLY\ AVG = \exp(\ln LTA + 0.388)$$

Since $e^{x+y} = e^x e^y$,

$$DLY\ AVG = (e^{\ln LTA})(e^{0.388}), \text{ or}$$

$$\mathbf{DLY\ AVG = 1.47 \times LTA}$$

Daily Maximum Limit

$$s^2 = \ln(0.6^2 + 1) = 0.307$$

$$s = 0.555$$

$$u = \ln LTA - 0.5(0.307)$$

$$u = \ln LTA - 0.154$$

At 99% probability, $Z = 2.326$, so

$$DLY\ MAX = \exp[\ln LTA - 0.154 + 2.326(0.555)]$$

$$DLY\ MAX = \exp(\ln LTA + 1.137)$$

$$DLY\ MAX = (e^{\ln LTA})(e^{1.137})$$

$$\mathbf{DLY\ MAX = 3.11 \times LTA}$$

Once the DLY AVG and DLY MAX concentration limits are determined, a mass limit can be calculated using the same effluent flow used to calculate the WLA.

Correction for Background Concentrations of Pollutants

In the development of water quality based effluent limitations, the preferred method of accounting for background concentrations of pollutants is through Total Maximum

Daily Load (TMDL) allocations. However, until TMDLs are approved and available for particular segments and pollutants of concern, the procedure described below will be used to screen applications and develop permit limits.

****Definitions****

For purposes of this section, the following definitions apply:

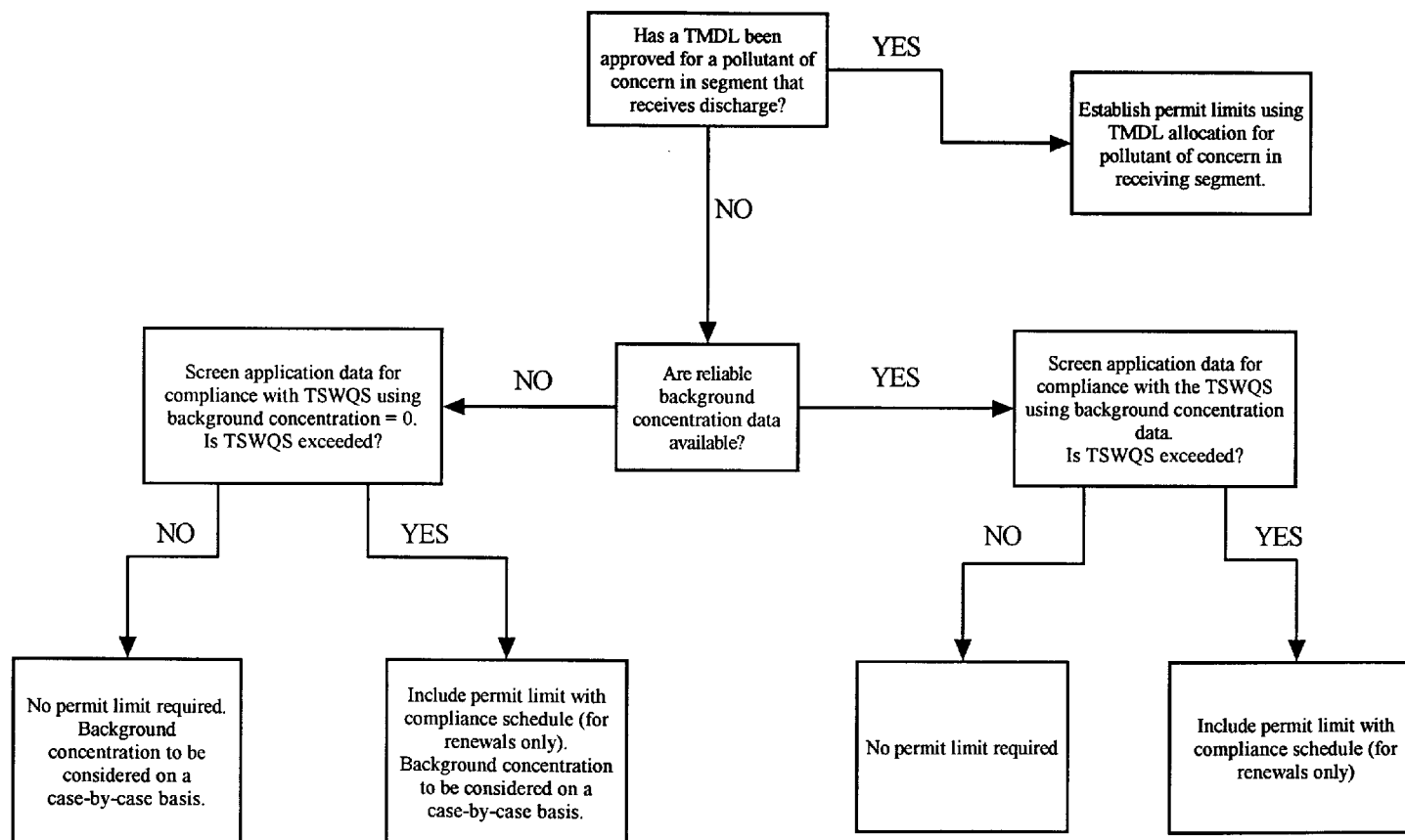
Background concentration: Refers to the water quality in a particular waterbody that would occur if that waterbody were relatively unaffected by human activities.

Ambient concentration: Refers to the existing water quality in a particular waterbody.

****Reliable Data****

- 1) Samples have been collected and preserved using techniques that conform with EPA-approved methods. Samples for metals must have been collected and preserved using clean techniques (as discussed in reference (3.a) below or equivalent).
- 2) Samples have been analyzed using EPA-approved methods, and the analyses meet agency-specified minimum analytical levels (MALs) for the pollutant(s) of concern.
- 3) Sample collection, preservation, handling, storage, analysis, quality assurance, and quality control procedures must be comparable to those specified in the following documents:
 - a) Water Quality Monitoring Procedures Manual, Texas Natural Resource Conservation Commission, August 1994 (or latest revision).
 - b) Work Plan/Quality Assurance Project Plan for Near Coastal Waters Project, Sec. 104(b)(3), Grant No. X-006559-01-0, Total Maximum Daily Loads of Selected Heavy Metals in the Houston Ship Channel, San Jacinto River (Tidal) and Upper Galveston

FIGURE 2. PROTOCOL FOR THE INCLUSION OF BACKGROUND CONCENTRATIONS IN ESTABLISHING PERMIT LIMITS



Bay, Texas Water Commission, Environmental Assessment Division, August 1993.

- c) Benoit, G. and Santschi, P. H., 1991; Trace Metals in Texas Estuaries; Prepared for the Texas Chemical Council; Texas A&M University at Galveston, Department of Marine Science.
- 4) Specific requirements include:
 - a) Freshwater samples must be collected during moderate or low stream flow conditions. Marine or tidally influenced water samples must be collected during low freshwater inflow conditions. Flow conditions should prevail for at least one week prior to data collection.
 - b) Field data (temperature, dissolved oxygen, pH, and conductivity) must be collected at each sampling site.
 - c) For metals, TSS and hardness measurements must be made at each freshwater sample site. Also, for silver, chloride measurements must be made at each sample site.
 - d) Vertical profiles will be conducted for field data collected as described in item (4.b). If no stratification is present, mid-depth samples may be taken, otherwise, vertically composited samples are necessary.

****Procedure****

The procedure for screening application data and developing permit limits is shown in Figure 2. For a particular pollutant and segment, the permit will incorporate a limit as established by the TMDL procedure if an approved TMDL exists. In the absence of an approved TMDL, application data will be screened using reliable background concentration data, if such data exist. Table 1 lists reliable background concentration data which will be used routinely in application screening. Data will be added to Table 1 as it becomes available. When reliable background concentration data are not available, data will be screened with the assumption that the background concentration is zero and permits will include a reopener clause. The assumption of a zero background concentration may be reconsidered on a case-by-case basis as new information becomes available.

When the background concentration is less than the instream criteria, a mass balance approach will be used to determine waste load allocations for affected

parameters. This approach is applicable for calculating permit limits for both aquatic life and human health protection.

$$WLA = \frac{\text{Criteria} - [(1 - \text{Fraction Effluent})(\text{Background})(\text{Fraction Available})]}{(\text{Fraction Available})(\text{Fraction Effluent})}$$

where

WLA	=	waste load allocation (Total concentration)
Background	=	background concentration of pollutant (Total concentration)
Criteria	=	numeric standard for the receiving water (Dissolved, Free Ion or Total concentration as specified in 30 TAC §307)
Fraction Effluent	=	proportional contribution of effluent to receiving water
Fraction Available	=	fraction of the pollutant that is defined to be bioavailable

When the background concentration is assumed to be zero, the equation reduces to those given in the "Derivation of Permit Limits for Aquatic Life Protection" and "Derivation of Permit Limits for Human Health Protection" sections of this document.

When the background concentration is equal to or greater than the instream criteria, the TNRCC will issue a "no degradation" permit with concentration limits equal to the instream criteria.

Once-Through Cooling Water Discharges

As stated in 30 TAC 307.8.(d), the TNRCC will not require water quality-based effluent limits for those pollutants discharged in once-through cooling water where no measurable increase occurs in the effluent as compared to the intake water. The term "no measurable increase" refers to a comparison of the discharge water to the intake water in which the pollutant's average concentration demonstrates no statistically significant difference at the 95% confidence interval. This standard applies exclusively to once-through cooling water discharges.

This provision excludes those facilities drawing intake water from one water body and subsequently discharging the once-through cooling water into a different water body. For these facilities, permits will include, where applicable, water quality-based effluent limits protective of the receiving water.

To demonstrate that no measurable increase in a pollutant occurs, the permittee should perform a statistical analysis comparing the discharge water to the intake water. The analysis should determine whether a pollutant's average concentration demonstrates a statistically significant difference at the 95% confidence level. The permittee should perform the statistical analysis on twelve (at a minimum) paired 24-hour composite samples, collected in consecutive months to account for seasonal effects. The term "paired" refers to both samples (intake and discharge) being collected within 24-hours of each other.

After collecting and analyzing the samples, the permittee should calculate the mean and standard deviation for each data set assuming a log normal distribution. The permittee should then use the two-tailed Student's t-test to compare the effluent data set to the intake water data set. Where portions of a data set are at unknown concentrations (below the MAL) for either the intake water or the discharge water, the permittee should adjust the mean and standard deviation calculations with an approved methodology. Examples of acceptable methods include the delta log normal approach as described in the **Technical Support Document for Water Quality-Based Toxics Control** (EPA /505/2-90-001, Appendix E), and the Cohen Test method described in the **Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance** (NTIS No. PB89-151047, Office of Solid Waste Management, Washington, D.C).

A determination of no measurable increase would most likely occur following permit renewal or a permit amendment. At that time, effluent screening of application data would have indicated a pollutant in concentrations equalling or exceeding 85% of its calculated daily-average water-quality-based limit. Therefore, the testing required for the statistical analysis would normally occur within the compliance period stated in the permit for that particular pollutant. This provision does not prevent the permittee from making a determination prior to submitting a permit application.

Collection of Site-Specific Data

The following are guidelines that the TNRCC has established for permittees collecting site-specific data for hardness, TSS, and partition coefficients. These parameters are used in the calculation of permit limits, and are estimates of conditions that exist in the receiving water. When a permittee believes the default values (see Table 6 for hardness, pH, and TSS defaults) inaccurately reflect actual conditions in their receiving water, they may collect data and submit it to the TNRCC for review.

****Partition Coefficient****

The TSWQS for the protection of aquatic life are expressed as dissolved concentrations, except where noted. The TNRCC has established the following guidelines for permittees who wish to develop a site-specific partition coefficient where one is not available, or to use in lieu of the coefficients given in Tables 4 and 5. The permittee must use clean techniques for all metals sampling and analytical procedures to avoid contamination. The upper 85th percentile value of the ratio, as ranked from lowest to highest, of the total/dissolved concentration is used as the fraction available in the Waste Load Allocation permit limit calculation.

- (1) Water samples can be collected in two ways:
 - (a) Collect samples from the receiving water outside the regulatory mixing zone. Mixing zones are defined in 30 TAC §307.8(b) of the TSWQS.
 - (b) Collect samples of the receiving water upstream of the discharge and mix it with the effluent at the proportion representative of critical (low flow) dilution. The critical dilution can be obtained from the TNRCC. If upstream water is not available, the critical dilution is 100%.
- (2) A minimum of 30 samples need to be collected. TNRCC prefers 30-50 samples to ensure that there are at least 30 valid data points and to get a more statistically reliable number. Samples should be collected to reflect different effluent characteristics that exist at various times of the day and week. Analytical metal concentrations (total recoverable and dissolved) are needed to calculate a partition coefficient.

For aluminum, new information indicates that the dissolved metal may underestimate the bioavailable fraction. In some circumstances, the total portion may be more toxic than the dissolved portion. Therefore, the permittee may need to demonstrate that the use of any partition coefficient that is different from that used by TNRCC, will not cause instream effects. To do this, the permittee should determine the No-Observable Effects-Level (NOEL) concentration for aluminum-spiked effluent using standard 48-hour acute toxicity tests. Once the NOEL concentration is determined, it will be used with the waste load allocation (WLA) acute criteria equation to derive permit limits that will not have instream effects.

****Hardness and TSS****

The permittee may collect hardness or TSS data in the receiving water so that TNRCC can use the site-specific data in calculating hardness-dependent standards or in calculating partition coefficients. In general, most metals are more toxic in soft

water (low hardness values), and therefore, more stringent permit limits will be imposed for locations with soft water. If the permittee believes that the hardness value used to calculate the water quality standard, and hence the permit limit for a given constituent is inappropriate, he may submit site-specific data to the staff. It is advisable to check with staff to find out what default hardness value was used in the TNRCC's calculations before collecting additional data. The TNRCC uses the 15th percentile basin or segment hardness data, as ranked from lowest to highest, to calculate the standard for hardness-based criteria. For TSS, TNRCC uses the 15th percentile basin or segment value to calculate a site-specific partition coefficient. The following paragraphs outline acceptable procedures for collection of site-specific hardness and TSS data.

The applicant should collect a minimum of 30 samples from the receiving water. TNRCC prefers 30-50 samples to ensure that there are at least 30 valid data points and to get a more statistically reliable number for estimating the 15th percentile. Measure hardness as mg/l CaCO_3 . Samples should not be reflective of the effluent hardness or TSS. Samples should be collected by any of the methods listed below, or any combination of the two.

- (1) Collect samples outside the regulatory mixing zone which is discussed in 30 TAC § 307.8(b) of the TSWQS and in the section of this document titled, "Defining Critical Conditions and Mixing Zones". The permittee should collect and analyze samples from the receiving water upstream of the discharge, if available.
- (2) Where the permittee uses receiving water as the control for biomonitoring tests, control hardness and TSS analyses may also be used to supplement any site-specific data. This is only applicable to permittees with biomonitoring requirements in their permit. Laboratory dilution water may not be used to provide hardness or TSS data.

Silver Translator (Freshwater) for Calculating Permit Limits

The TSWQS express the criterion for silver in the free ionic form. The free ionic criterion must be translated into a total recoverable permit limit. This section describes the translation method.

First, the proportion of total silver that is in the dissolved form must be calculated. This is accomplished by using a partition coefficient. The partitioning of metals between filtrate and filter-retained forms is often quantified in terms of an empirical partition coefficient, K_d . TNRCC staff will use a partition coefficient derived from data collected by the Texas Environmental Advisory Council (TEAC). In 1994, the

TEAC conducted statewide sampling of various waterbodies and analyzed for both total and dissolved silver concentrations, and TSS. Using this information, the TNRCC used the following regression equation (R^2 of 71 percent) to predict K_d values for any given level of TSS:

$$\log(K_d) = b + m(\log[TSS])$$

which can alternatively be written:

$$K_d = 10^b * (TSS)^m$$

where,

K_d = Partition Coefficient

b = intercept (found in Table 4)

TSS = Total Suspended Solids (mg/l)

m = slope (found in Table 4)

Using the partition coefficient (K_d), the fraction of dissolved metal can then be calculated using EPA's* equilibrium model, MINEQL+STANFORD. MINEQL uses the equilibrium constant approach to predict dissolved metal species at equilibrium. To account for adsorption, the partition coefficient (K_d), and suspended solids concentration (TSS), are used to calculate the dissolved fraction of silver using the following equation:

$$\frac{C}{C_T} = \frac{1}{(1 + K_d * TSS * 10^{-6})}$$

Where:

C_T = total metal concentration

C = dissolved metal concentration

Next, staff calculate the percentage of dissolved silver that is present in the free ionic form. Data collected from a variety of waterbodies throughout the United States*, show that a correlation exists between the dissolved chloride concentration and the percent free ionic silver. The TNRCC developed a regression equation (R^2 of 87 percent), that calculates the percentage of dissolved silver that is in free ionic form. The following equation is then used to determine what percentage of dissolved silver is in this form.

$$Y = \exp \left[\exp \left(\frac{1}{0.6559 + 0.0044(Cl)} \right) \right]$$

Y = % of dissolved silver that in the free ionic form

Cl = dissolved chloride concentration (mg/l)

For this equation, chloride values are obtained from the TNRCC's Stream Monitoring Network database or from site-specific data. The 50th percentile value of the dissolved chloride concentration for each basin will be used unless sufficient segment chloride values are available. If the permittee believes that the chloride value used to calculate the water quality standard, and hence the permit limit for silver is inappropriate, he may submit site-specific data to the staff. It is advisable to check with staff to find out what default chloride value was used in the TNRCC's calculations before collecting additional data. When the range of chloride values exceeds 140 mg/l (the upper extent of the TNRCC data range), the percentage of silver in the free ionic form will be 8.98%.

Finally, the proportion of dissolved silver that is in the free ionic form is multiplied by the proportion of total silver that is dissolved. This number will be used in the Waste Load Allocation (WLA) equation. For example, if the percent dissolved silver is 30%, and the percent in the free ionic form is 50%, the fraction available used in the WLA equation is 0.15 (0.3 multiplied by 0.5).

* "Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part 1 (Revised 1985)," EPA 600/6-85-002a.

Calculation of Chromium Permit Limits

The TSWQS for the protection of aquatic life are expressed as dissolved concentrations for Hexavalent Chromium (Cr^{+6}) and Trivalent Chromium (Cr^{+3}). The method to calculate permit limits for Total Recoverable concentrations of Cr^{+3} and Dissolved concentrations for Cr^{+6} is described in this section.

As part of the permit application, the permittee will analyze their effluent for dissolved Cr^{+6} and total recoverable chromium. The TNRCC assumes that total recoverable chromium is the sum of dissolved Cr^{+6} , dissolved Cr^{+3} , and adsorbed Cr^{+3} .

$$Total\ Cr = dis\ Cr^{+6} + dis\ Cr^{+3} + ads\ Cr^{+3}$$

The analytical method for Cr^{+6} measures only for the dissolved form. The TNRCC assumes that the amount of adsorbed Cr^{+6} is negligible. Therefore, total Cr^{+3} is calculated by subtracting dissolved Cr^{+6} from the total recoverable chromium.

$$\text{Total Cr}^{+3} = \text{total Cr} - \text{dis Cr}^{+6}$$

The partition coefficient for chromium, listed in Table 4, is not applicable to Cr^{+6} , because dissolved concentrations alone are measured. Therefore, the Cr^{+6} permit limit will be calculated using standard procedures and assuming 100% of Cr^{+6} is dissolved. The effluent concentration will be compared to the calculated permit limit to determine if monitoring or permit limitations are needed.

The calculation of Cr^{+3} permit limits will use the partition coefficient in Table 4 and standard procedures. The calculated permit limit will be compared to the total Cr^{+3} concentration in the effluent to determine if monitoring requirements or permit limitations are needed. The calculation of chromium limits for the protection of human health will use the partition coefficient in Table 4 and standard procedures. The permit limit will be expressed as total recoverable chromium.

Calculation of Total Dissolved Solids Permit Limits

Concentrations and the relative ratios of dissolved minerals such as Total Dissolved Solids (TDS) and individual components of TDS such as chlorides and sulfates will be maintained to protect significant aquatic life uses and attainable uses. The aquatic life attributes in 30 TAC § 307.7(b)(3)(A) are used to assign the aquatic life use categories. For discharges to freshwater, a screening procedure will be used to determine if either a TDS permit limit, or further study of the receiving water is required. Screening may also be performed for individual components of TDS, such as chlorides and sulfates.

For discharges to saltwater, TDS will be evaluated on a case-by-case basis. Even though salinity criteria have not been established, the absence of numerical criteria shall not preclude evaluations and regulatory actions based on estuarine salinity. Careful consideration will be given to all activities which may detrimentally affect estuarine salinity gradients.

The screening procedure will be applied to all domestic dischargers with a permitted flow ≥ 1 MGD, industrial majors, and industrial minors with process water. The screening procedure (Equation 1) compares the concentration of TDS downstream of the discharge (after effluent mixing) with the TDS criterion (C_C) for the segment. Screening values in Equation 1 will typically be the segment TDS criteria found in Appendix A of the TSWQS. Ambient values (C_A) are representative of the mean

segment TDS concentration. The mean concentration of TDS in a segment is taken from the most recent State of Texas Water Quality Inventory (305b) report. The permittee may supply site-specific data when either the segment criterion or the mean TDS concentration does not appear to be representative of the TDS concentration of the receiving water after mixing occurs. The screening procedure is fully satisfied (no further action is required) when Equation 1 is met:

Equation 1:

$$C_C \geq \frac{Q_S C_A + Q_E C_E}{Q_E + Q_S}$$

Q_S = Harmonic Mean flow (cfs) of the first perennial downstream waterbody

C_A = TDS (mg/l) ambient concentration

Q_E = Average of the daily average effluent flows
over the last two years (cfs)

C_E = TDS (mg/l) in effluent

C_C = TDS (mg/l) segment criterion

If a discharge minimally exceeds C_C in Equation 1, the permittee will be required to monitor TDS in the effluent and assess any impacts the discharge is having on aquatic life downstream of the discharge. A re-opener clause will be included in the permit specifying that permit limits will be imposed if the discharge is found to impair aquatic life uses due to TDS. If a discharge significantly exceeds C_C , an effluent limit for TDS will be placed in the permit. In this case, the permittee will need to demonstrate that the discharge is having no impacts on aquatic life downstream of the discharge in order to justify the removal of the TDS limits through a permit amendment action.

If the screening value is exceeded by a proposed discharge, the permittee will need to submit evidence of additional controls and/or other measures to ensure protection of the receiving waters.

If the screening value is exceeded by an existing discharge, the permittee will need to demonstrate that the discharge does not impair the receiving water uses and/or they may substitute site-specific TDS data to be used in Equation 1 (see Figure 3). TDS values that more accurately reflect site-specific conditions can be collected in the vicinity of the discharge area. This site-specific TDS value would replace the ambient mean TDS value (C_A) found in Equations 1 and 2. In order to satisfy the requirements for site-specific data collection, fifty (50) TDS or conductivity values need to be collected over the course of one year. These values should reflect

conditions in the receiving water, either upstream or outside of the regulatory mixing zone, that exist during different seasons and stream flow regimes. Once a new ambient value is accepted, Equation 1 will be re-evaluated. If the screening equation is satisfied, the permittee may amend the permit to request removal of the TDS permit limits. No further action will be taken. If the permittee wishes to change the segment specific TDS value, a more intensive study will be needed (Figure 3). Such a study will encompass sampling of the whole classified segment under various flow regimes and seasons. A site-specific standards amendment is then needed to change the TDS segment criterion in the TSWQS.

A methodology to determine if the existing discharge is causing instream impairment, is to compare the aquatic life uses upstream and downstream of the discharge. When performing this type of study, the Rapid Bioassessment Protocol (II) outlined in the EPA document (EPA/444/4/89-001) should be followed. The study should include a comparison of the macroinvertebrate community in waters impacted by the discharge, to the community in an upstream site or a representative unimpacted site in the same watershed. The study should be conducted during critical instream conditions (low flow). A comparison of the total scores for each site provides a final evaluation of biological condition. Habitat assessments, physical characterization, and water quality data can also be used in the final evaluation. If the receiving waters are found to be impaired downstream of the discharge, control strategies for TDS will be evaluated and numeric controls such as a TDS permit limit will be recommended by TNRCC staff. The following equation will be used by staff to calculate a TDS permit limit:

Equation 2:

$$C_E = \frac{[(C_C)][Q_E + Q_S] - [(Q_S)(C_A)]}{Q_E}$$

Q_S = Harmonic Mean flow (cfs) of the first perennial waterbody

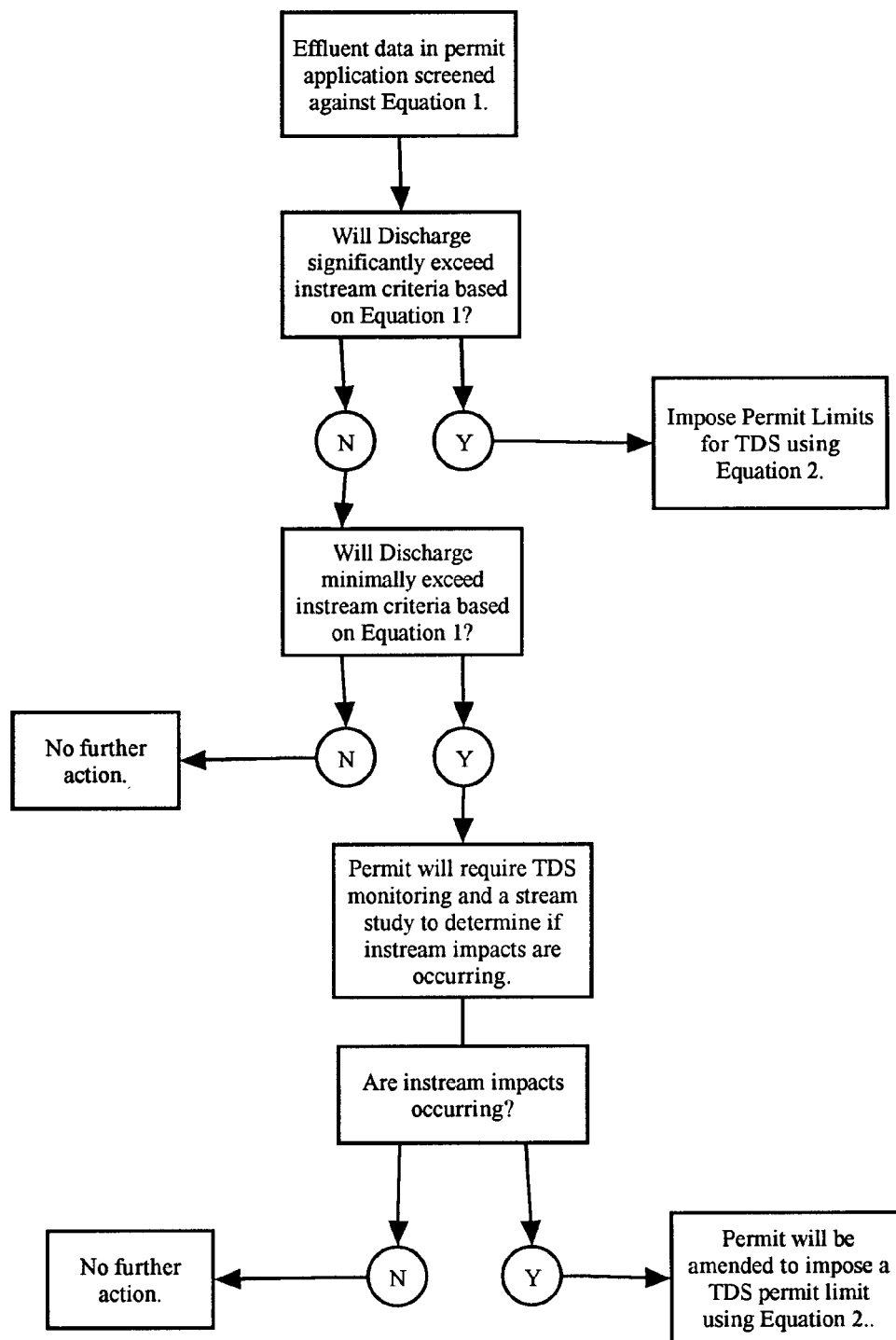
C_A = TDS (mg/l) ambient concentration (segment mean)

Q_E = Average of the daily average effluent flows
over the last two years (cfs)

C_E = TDS (mg/l) in effluent

C_C = TDS (mg/l) screening level (segment criterion)

FIGURE 3. ESTABLISHING PERMIT LIMITS FOR TOTAL DISSOLVED SOLIDS



The calculated effluent concentration, C_E , is an annual average concentration from which daily average and daily maximum permit limits may be determined by considering C_E to be a Waste Load Allocation (WLA) averaged over 365 days and calculating a Long-Term Average (LTA) effluent concentration. This procedure is outlined in the section of this document entitled "Derivation of Permit Limits for Human Health Protection".

- Freshwater Streams

Discharges directly to an unclassified waterbody or classified segment must meet the screening value (C_C) at the edge of the mixing zone (see section of this document titled, "Defining Critical Conditions and Mixing Zones"). The arithmetic mean TDS value (C_A) from the Water Quality Inventory Report will be used as the ambient concentration, unless the permittee supplies site-specific data. Equation 2 will be used to calculate permit limits for discharges to unclassified and classified freshwater streams, with C_C taking the value of the TDS criterion. If the concentration of TDS in the effluent causes a significant exceedance of C_C in Equation 1, a permit limit for TDS will be imposed. The permittee must then demonstrate that either the attainable uses of the receiving waters are not impaired by the discharge, or provide site-specific data for C_A , C_C , and/or Q_S in Equations 1 and 2.

- Lakes

Screening levels for discharges to unclassified lakes will be determined on a case-by-case basis. The secondary maximum contaminant levels for drinking water (SMCL's, given at 30 TAC § 290.101 - 290.119) will be considered if the lake is a public water supply. Discharges into classified lakes must meet the segment criteria for TDS at the edge of the mixing zone. The arithmetic mean value from the Water Quality Inventory Report will be used as the ambient concentration (C_A), unless the permittee supplies site-specific data. The TNRCC staff will determine if a biological survey is necessary to evaluate the effect of TDS on the uses of the receiving water.

- Unclassified and Classified Tidal Rivers and Estuaries

Discharges to tidal rivers and estuaries will be handled on a case-by-case basis. Surface waters will be protected from the adverse effects of dissolved salts. The absence of numerical criteria shall not preclude evaluations and regulatory actions based on estuarine salinity.

Establishing Permit Limits for Toxic Materials for Which There are No Texas Surface Water Quality Standards

In some instances, potentially toxic materials for which no specific numerical criteria have been developed, are used in the treatment process or are present in an effluent. Where necessary, a permit limit will be developed for these materials using available toxicity data and the method described in this section. The receiving waters will be protected for acute/chronic toxicity. Critical conditions of the receiving waters will be established using methods consistent with other sections of this document. In accordance with 30 TAC § 307.6 (c)(7), water quality criteria will be established using the methods described below.

Specific numeric criteria will be calculated using the method outlined in "Guidelines for Deriving Criteria for Aquatic Life and Human Health", (45 FR 79341 November 28, 1980 and 50 FR 30784, July 29, 1985) if toxicity data requirements outlined in that document are met. If the data requirements are not met, the specific acute numerical criteria will be calculated as follows:

$$ACUTE\ CRITERIA = (LC_{50}\ of\ most\ sensitive\ species) (0.3)$$

Chronic numerical criteria will depend on the persistence and bioaccumulative capacity of the material. The method for deriving chronic criteria is consistent with 30 TAC § 307.6(c)(7). For non-persistent toxic materials:

$$CHRONIC\ CRITERIA = (LC_{50}\ of\ most\ sensitive\ species) (0.1)$$

For persistent toxic materials:

$$CHRONIC\ CRITERIA = (LC_{50}\ of\ most\ sensitive\ species) (0.05)$$

For toxic materials that bioaccumulate:

$$CHRONIC\ CRITERIA = (LC_{50}\ of\ most\ sensitive\ species) (0.01)$$

A toxic material is considered to be persistent if it has a half-life in water of greater than 4 days. Toxicity data used in these equations should be derived from tests using the most sensitive species. There may be instances when toxicity data are only available for species not representative of the receiving waters, test durations

are varied, or other circumstances exist which will require a method that differs from the one described in this section.

If acute or chronic criteria need to be derived for biocides, other water treatment chemicals, or other constituents present in the effluent for which water quality standards are not established, the methods described above will be used. The following information is typically needed to determine these criteria:

- Product information sheet
- Product toxicity data
- Permitted discharge volume
- Expected concentration of product in effluent
- Discharge location

Water quality criteria for human health protection will be derived in accordance with 30 TAC § 307.6 (d) (8 and 9).

Deriving Permit Limits for Human Health Protection

Water in the state shall be maintained to preclude adverse toxic effects on human health resulting from contact recreation, consumption of aquatic organisms, or consumption of drinking water after reasonable treatment. Specific human health concentration criteria are applicable to waters in the state which have sustainable fisheries and/or designation or use as a public drinking water supply. These criteria do not, however, apply within mixing zones and below harmonic mean stream flows.

In order to calculate the instream concentration of a toxic substance in a stream or river, the staff will use the general approach found in the EPA manual entitled "Technical Support Document for Water Quality-based Toxics Control, (EPA/505/2-90-001)" and will use the harmonic mean flow for the nearest gauging station or available site specific information. The effluent flow rate that is used for dilution calculations will be determined on a case-by-case basis. Domestic discharges assessments will generally be based upon their daily average permitted flow. Industrial discharges will generally be assessed based upon the average of monthly average flow values over the preceding two-year period. All water with sustainable fisheries will be protected at the incremental cancer risk level of 10^{-5} including:

- all designated segments and perennial streams with a stream order of three or greater;
- lakes having a volume equal to or greater than 150 acre-feet and/or a surface area equal to or greater than 50 acres;

- all bays, estuaries and tidal rivers; and
- any other waters which potentially have sufficient fish production or fishing activity to create a significant long-term human consumption of fish.

Additionally the 10^{-5} risk level applies to:

- any discharge located within three miles upstream of a drinking water supply; or
- any discharge located within three miles of a perennial stream with a stream order greater than or equal to three.

Waters with an aquatic life use but no sustainable fishery, will be considered to have an incidental fishery. Numerical criteria applicable to incidental fishery waters are ten times the human health water quality standards because the standards specify fish consumption rates of 1.0 and 1.5 grams per person per day for incidental fisheries, compared to 10 and 15 grams per person per day for sustainable fisheries.

Specific human health criteria are applied as long-term average exposure criteria designed to protect populations over a life time (70 years).

Derivation of Permit Limits For Human Health Protection

First, a waste load allocation (WLA) is determined. The WLA equals the effluent concentration that will not cause criteria to be exceeded outside the mixing zone. The WLA is considered to be an annual average ($n = 365$ days). A long-term average, daily average, and daily maximum are calculated using the same equations that were used for the aquatic life calculations.

$$WLA = \frac{\text{Criteria}}{(\text{Fraction Available})(\text{Fraction Effluent})}$$

where

Criteria	=	human health numeric standard for the receiving water
Fraction Effluent	=	proportional contribution of effluent to receiving water
Fraction Available	=	fraction of the pollutant which is defined to be bioavailable

$$LTA = 0.930 \times WLA \quad [99\% \text{ probability, } n = 365]$$

$$DLY \text{ AVG} = 1.47 \times LTA \quad [99\% \text{ probability, } n = 12]$$

$$\text{DLY MAX} = 3.11 \times \text{LTA}$$

[99% probability, n = 12]

Calculation of Dioxin/Furan Permit Limits

The TNRCC addresses the differences in the relative toxicity of dioxin/furan congeners in comparison to 2,3,7,8 TCDD (most toxic dioxin/furan congener) with the use of Toxicity Equivalency Factors (TEFs). The Environmental Protection Agency (EPA) has listed TEFs for eleven dioxin/furans in the document titled, "Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans and 1989 Update (EPA/625/3-89/016)." The TNRCC adopted TEFs for seven congeners in the 1991 revision of the TSWQS. These criteria were retained in the 1995 revisions. The compounds and their TEFs as adopted by the TNRCC are given in the table that follows.

The concentration of each dioxin/furan compound in an effluent analysis is multiplied by the compound's TEF. The sum of these products of concentrations and TEFs is the Toxicity Equivalence (TEQ) of the mixture, expressed as if the toxicity were due entirely to 2,3,7,8 TCDD. The potential additive effects of various forms of dioxin/furans with different relative toxicities are thereby taken into account. The TNRCC will evaluate compliance with appropriate dioxin/furan permit limits based on this TEQ method. If a permittee is required to monitor its effluent for dioxin/furans, they may also be required to sample receiving water fish tissue and/or sediments for dioxin/furans.

COMPOUND	TEFs
2378 TCDD	1
12378 PeCDD	0.5
2378 HxCDD's	0.1
2378 TCDF	0.1
12378 PeCDF	0.05
23478 PeCDF	0.5
2378 HxCDF's	0.1

Dioxin/Furan permit limits are calculated in a manner similar to the method outlined previously (see, "Derivation of Permit Limits For Human Health Protection"). First, a waste load allocation (WLA) is first determined. The WLA equals the effluent concentration that will not cause an exceedance of instream criteria outside the

mixing zone. The WLA is considered to be an annual average (n = 365 days). A long-term average and daily maximum are then calculated using the same equations as human health calculations. The daily average permit limit has been replaced with an annual average permit limit which is equal to the WLA. The annual average permit limit is evaluated on the calendar average.

$$\text{WLA} = \text{Criteria} / [\text{Proportion of Effluent at mixing zone} \times \text{Fraction Dissolved}]$$

$$\text{LTA} = 0.930 \times \text{WLA} \text{ (99\% probability)}$$

$$\text{ANNUAL (calendar) AVG.} = \text{WLA}$$

$$\text{DAILY MAX.} = \text{LTA} \times 3.11$$

Establishing Permit Limits

Application Screening

For each application, the TNRCC staff will calculate the effluent limits required to maintain the surface water quality standards based upon the instream criteria established in 30 TAC § 307.6 (c and d). If an industrial or domestic effluent contains a toxic substance on the numerical criteria list which equals or exceeds 70% of calculated daily average effluent limit, the applicant will be required to submit historical data, or to resample and conduct additional analyses. Unless data is already available from the application, four additional composite samples (except for substances where test methods require grab samples) should be collected and analyzed. If the average of the effluent data (must be like samples, i.e., all composites or all grabs) is equal to or greater than 85% of the calculated daily average limit, the permit will be drafted to establish appropriate permit limits for the toxic substance of concern. The permit will specify a compliance period to achieve this limit if necessary. If the average of the effluent data equals or exceeds 70%, but is less than 85% of the calculated daily average limit, monitoring for the toxic substance of concern will be required.

If a toxic material is not detected (using the appropriate analytical methods) in any of the four retests, and the non-detectable level is equal to or less than the Minimum

Analytical Level (MAL), then a value of zero is assumed when calculating the average. If any of the four retests detect the toxic substance, then a value of one-half the non-detectable level that the applicant reported or one-half of the TNRCC MAL, whichever is less, will be used for averaging. If a toxic substance is quantified below the MAL and equals or exceeds 70% of the calculated daily average permit limit, the applicant may be required to submit historical data or to retest as stated above, and the applicant may be required to establish a site-specific MAL for the effluent.

Analytical Procedures

As required by 30 TAC §319.11, all analyses of effluents shall meet the requirements specified in the regulations published in 40 CFR Part 136 or the latest edition of "Standard Methods for the Examination of Water and Wastewater". If any regulated pollutant is not included in 40 CFR Part 136 or Standard Methods, the permittee may use a TNRCC-recommended analytical methods or a method approved for the specific compound in water or wastewater by the Environmental Protection Agency (EPA). All quality assurance/quality control practices shall strictly adhere to those outlined in each EPA-approved analytical method.

The MALs were developed by the TNRCC to establish a benchmark for analytical procedures for measuring the toxic pollutants regulated by 30 TAC § 307.6. One of the goals of establishing the MALs has been to provide consistent analytical data for industrial and municipal permit applicants and compliance monitoring of their discharges. The MALs serve as a measure of the analytical sensitivity of each laboratory procedure performed on standard laboratory equipment by qualified personnel.

There are various terms used to quantify sensitivity of analytical test procedures. In 40 CFR 136 Appendix B, the method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, and is determined from the analysis of a sample in a given matrix containing the analyte. In 30 TAC 307, the minimum analytical level (MAL) is defined as the lowest concentration at which a particular substance can be quantitatively measured with a defined precision level, using approved analytical methods. The MAL is not the published MDL for an EPA-approved analytical method, which is based on a single laboratory analysis of the substance in reagent (distilled) water. The MAL is based on analyses of the analyte in the matrix of concern (i.e., wastewater effluents). The TNRCC will establish general MALs that will be applicable when information on matrix-specific MALs are unavailable. General MALs are established in this document.

Table 7, TNRCC Minimum Analytical Levels for Application Screening, is a simplified version of Table 8. Table 8, 1995 Analytical Methods for the Determination of Pollutants Regulated by 30 TAC, Chapter 307, Section 307.6, lists TNRCC-recommended analytical methods, the MALs, the MDLs, and a brief description of how the MALs were derived.

Defining Permit Limits

Permit limits will normally be expressed in terms of total recoverable concentrations. The permit limit will be expressed as the calculated daily average/daily maximum concentration limits and/or daily average/daily maximum mass limits. If the permit limit is lower than the MAL, then a level of compliance will be established in the permit based upon the MAL except where a substance is of particular concern (e.g., if the toxicant has a high bioconcentration factor). If the TNRCC believes it is necessary to establish a permit level of compliance below the MAL, the permittee will be required to develop an effluent-specific MDL. When necessary, the permit applicant may request an opportunity to demonstrate an alternative effluent-specific MAL to account for interfering factors associated with the wastewater in question. See discussion for requesting an alternate MAL through the alternate analytical test method procedure in the "Alternate Analytical Test Methods" section of this document. The staff will use 30 TAC § 319 and best professional judgement when establishing monitoring frequencies.

Alternate Analytical Test Methods

Because of interferences and matrix problems associated with the analysis of toxics in the wastewaters, the TNRCC has received requests for the use of alternate analytical test method procedures. The procedures may range from an alteration of an Environmental Protection Agency (EPA) approved reference method, to a completely new, or "candidate" method. Guidelines are given below for the acceptance or rejection of those alternate analytical test methods for compliance monitoring of state issued permits. This is not in conflict with the approval authority that EPA retains for NPDES permits.

If a permittee wishes to initiate the evaluation process for an alternate analytical test method procedure, the permittee may send a written request for authorization to the Quality Assurance Specialists in the Field Operations Division. The request must include details required by 30 TAC §319.12. The information required in 40 CFR §136.4(c) (Application for Alternate Test Procedures), should also be submitted. All candidate methods should undergo a comparability study. A comparability study

should compare the performance of the alternate or candidate analytical method to an EPA-approved reference method. If the permittee cannot attain the MAL for a specific pollutant and has exhausted all available techniques to solve interference and matrix problems, they may apply for an alternate MAL through the alternate analytical test method procedure provided that all documentation of attempted solutions to the interference/matrix problems is included with the application. This documentation must include all quality assurance/quality control data. Because analysis of cyanide by the amenable to chlorination method has frequent interferences from organics, the TSWQS indicate that compliance can be determined using this method, or the weak acid dissociable method.

Total Toxicity Testing (Biomonitoring)

The TNRCC may require total (whole effluent) toxicity testing, also known as biomonitoring, in permits where the potential exists for the effluent to exert toxicity in the receiving water. The TNRCC generally requires biomonitoring for domestic wastewater facilities with a flow of 1 MGD or greater, most major industrial facilities, and other facilities that have the potential to exert toxicity in the receiving water. The TNRCC requires two types of toxicity tests: whole effluent tests based on receiving water dilution, and 100%, end-of-pipe acute toxicity tests.

Chronic and 48-hour Whole Effluent Toxicity Testing (Biomonitoring)

The TNRCC may require permittees to conduct 48-hour acute or 7-day chronic toxicity tests to measure compliance with the TSWQS (30 TAC § 307.6(e)). The permit will specify that the test be conducted using the latest version of an EPA method. The permittee may use a revised method if one becomes available during the term of the permit. Depending on the type of receiving water, the permit will specify 48-hour acute or chronic tests to preclude toxicity to freshwater or saltwater organisms. The test organisms for each type of test are listed below:

Freshwater streams and lakes (salinity <2 ppt)

- 3-brood Ceriodaphnia dubia (cladoceran crustacean) chronic survival and reproduction test
- 7-day Pimephales promelas (fathead minnow) chronic larval survival and growth test
- 48-hour Daphnia pulex (cladoceran crustacean) acute survival test
- 48-hour Pimephales promelas (fathead minnow) acute survival test

Marine receiving water (salinity ≥ 2 ppt)

- 7-day Mysidopsis bahia (mysid shrimp) chronic survival and growth test
- 7-day Menidia beryllina (inland silverside) chronic larval survival and growth test
- 7-day Cyprinodon variegatus (sheepshead minnow) chronic larval survival and growth test (Generally, permits will no longer require this species.)
- 48-hour Mysidopsis bahia (mysid shrimp) acute survival test
- 48-hour Menidia beryllina (inland silverside) acute survival test
- 48-hour Cyprinodon variegatus (sheepshead minnow) acute survival test (Generally, permits will no longer require this species.)

Permittees may substitute other representative, sensitive species if they obtain approval from the TNRCC during the permit application process (see sections on "Toxicity Attributable to Dissolved Inorganic Salts" and "Site-Specific Total Toxicity Standards").

The TNRCC will require toxicity testing of domestic wastewater dischargers: 1) that have a daily average permitted flow of 1 MGD or greater, or 2) that have a final phase of their permit with a design flow of 1 MGD or greater during the term of the permit, or 3) that have an approved pretreatment program, or 4) that the staff believe have the potential to exert toxicity in the receiving water. For those permittees currently permitted at less than 1 MGD, but have an Interim or Final Phase of 1 MGD or greater, biomonitoring requirements will begin upon expansion to that phase.

The TNRCC also requires toxicity testing of: 1) most EPA-classified major industrial dischargers with continuous-flow outfalls, and 2) industrial dischargers with continuous-flow outfalls with the potential for exerting toxicity. The TNRCC will generally not require toxicity testing of EPA-classified minor industrial dischargers or once-through cooling water outfalls for industrial facilities. However, the TNRCC may require toxicity testing of once-through cooling water if: 1) the permittee applies water treatment chemicals or biocides at a frequency and concentration that would raise significant concerns to TNRCC, or 2) TNRCC determines that the effluent has the potential to exert toxicity in the receiving water, or 3) water quality-based permit limits to protect aquatic life are specified for that outfall, or 4) other potentially toxic wastestreams are commingled with the once-through cooling water. Water quality-based permit limits to protect aquatic life are numerical limits for one or more specific toxicants derived from the aquatic life criteria in the TSWQS. The TNRCC may also require biomonitoring of once-through cooling water outfalls if the intake water and receiving water are different water bodies. The TNRCC may require

toxicity testing of EPA-classified minor industrial discharges that the staff determine have the potential to exert toxicity in the receiving water.

Figures 4 and 5 illustrate the general toxicity testing frequencies for domestic and industrial wastewater treatment facilities. Different frequencies may be specified on a case-by-case basis. For both industrial and municipal facilities, TNRCC will require biomonitoring for the life of the permit. TNRCC may require a different testing frequency for each of the test species (invertebrate and vertebrate).

In Figures 4 and 5, two numbers are given at the end of each decision tree (e.g., 2/1). These numbers indicate the testing frequency the TNRCC will place in the permit. The first number indicates the number of tests per year the TNRCC will require for the more sensitive species. The second indicates the number of tests per year the TNRCC will require for the less sensitive species. For example, the notation 2/1 means the TNRCC will require the permittee to biomonitor once per six months for the sensitive species and once per year for the less sensitive species. TNRCC will determine which species is more sensitive from the results of biomonitoring tests previously conducted as a requirement of a TNRCC permit, or from toxicity test results submitted with the application. The TNRCC will assume that the invertebrate species is the more sensitive if toxicity test data is not available.

For domestic wastewater treatment plants, the TNRCC will base the required toxicity test frequency on the permitted flow of the plant, whether the facility has a pretreatment program, and whether water quality-based permit limits for the protection of aquatic life are required. For industrial wastewater treatment plants, the TNRCC will base the required toxicity test frequency on whether water quality-based permit limits for the protection of aquatic life are required.

The TNRCC may require more frequent biomonitoring of permittees that have historical biomonitoring problems. When reviewing test results for historical problems, the TNRCC will consider how long ago the test failures occurred, the number of tests conducted in the past, and any new treatment capabilities (that have been in use since the biomonitoring failures).

Figure 4. Biomonitoring Frequencies for Domestic Major or Minor Permits

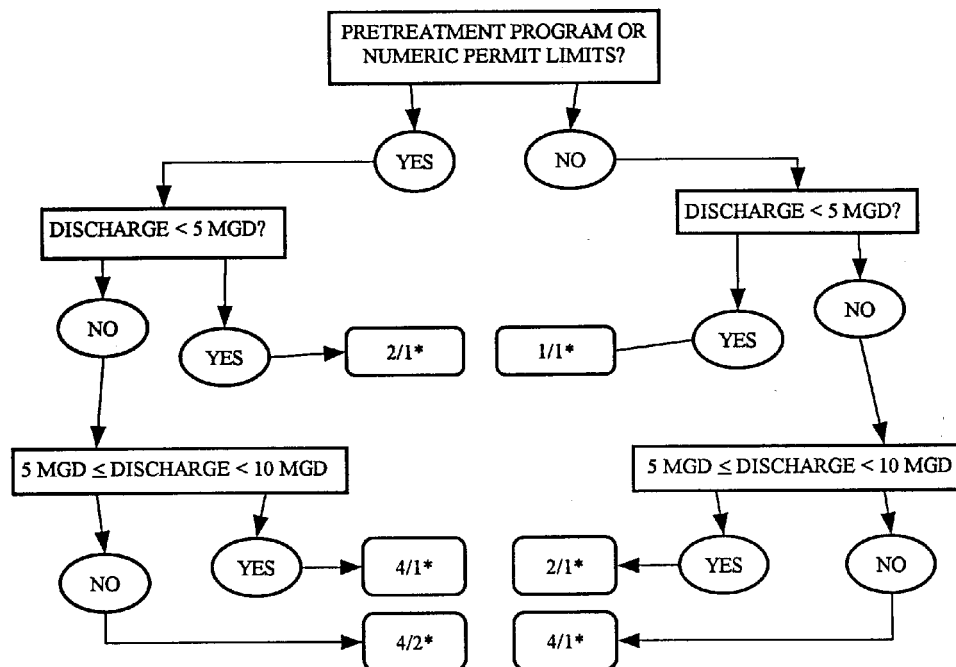
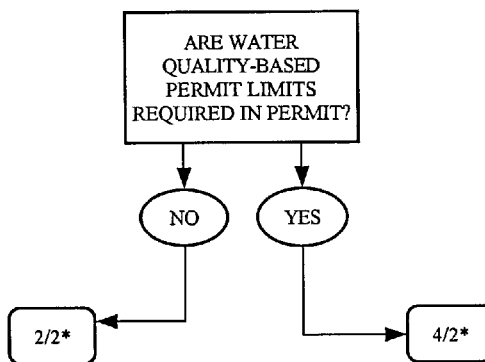


Figure 5.
Biomonitoring
Frequency for
Industrial
Permits



* Frequencies may increase if permittee has had historical biomonitoring problems.

The TNRCC will normally require that industrial or domestic dischargers test at a frequency of 4/1 if the permittee is conducting a Toxicity Reduction Evaluation (TRE) when they submit a permit application. Biomonitoring frequencies may be specified on a case-by-case basis where seasonal toxicity is apparent. The TNRCC will use professional judgement to establish testing frequencies when a chemical specific limit, whole effluent toxicity (WET) limit, or Best Management Practice (BMP) is placed in the permit to control effluent toxicity.

Complementing the total toxicity testing requirements, the TNRCC will require that all domestic dischargers with a daily average permitted flow equal to or greater than 1 MGD dechlorinate their chlorinated effluent or convert to another form of disinfection. At this time, the TNRCC will not require effluent dechlorination for those facilities discharging directly to the Rio Grande.

The TNRCC will determine what type of toxicity test (freshwater or marine, acute or chronic) to place in the permit based on the salinity and low flow conditions of the receiving waters. There may be instances when TNRCC uses higher flow periods and/or storm events to determine the type of biomonitoring. The TNRCC staff will coordinate with the EPA to help ensure that both the state and federal permits have the same biomonitoring requirements when possible. TNRCC and EPA biomonitoring requirements may differ because of the standards or policies in effect at the time the permit is drafted.

In addition to the type of toxicity tests, the permit language will define a dilution series and a critical dilution. The critical dilution represents the percentage of effluent at the edge of a mixing zone during critical low flow (normally use the 7Q2 flow), or critical mixing conditions. The results at the critical dilution are statistically compared with the results at the control (0% effluent) to measure compliance with the TSWQS. The dilution series consists of four (4) effluent concentrations in addition to the critical dilution. For domestic dischargers, TNRCC generally uses a permittee's daily average permitted flow to calculate the critical dilution. For industrial dischargers, TNRCC generally uses the highest monthly average discharge flow from the preceding two years to calculate the critical dilution for existing facilities, and the design flow to calculate the critical dilution for new facilities.

For permittees that discharge into intermittent streams, the TNRCC will require acute toxicity (48-hour) tests with a critical dilution of 100% effluent. The TNRCC will require permittees that discharge into intermittent streams with perennial pools to conduct chronic biomonitoring with a critical dilution of 100% effluent. The TNRCC may require dischargers to conduct chronic biomonitoring to protect intermittent streams that may have seasonal aquatic life uses. The TNRCC will determine the critical dilution from the typical flows in the season in which the use occurs.

The TNRCC will require permittees that discharge into intermittent streams that flow into a perennial stream within a moderate distance downstream (normally 3 miles) to conduct 48-hour acute or chronic tests. The type of tests TNRCC will require depends on the permitted discharge volume, and flow of the perennial water downstream. If the permitted flow of the discharge exceeds 10% of the low flow of the perennial water, TNRCC will require the permittee to conduct chronic biomonitoring with a critical dilution representative of the percentage of effluent in the perennial stream during low flow. If the permitted flow of the discharge is less than 10% of the low flow in the perennial stream, TNRCC will require the permittee to conduct 48-hour acute toxicity tests with a critical dilution of 100% effluent. TNRCC will generally require permittees that discharge into intermittent streams, within 3 miles of a bay, estuary, or tidal river, to conduct chronic marine biomonitoring.

TNRCC will require permittees that discharge into waters with an aquatic life use to conduct chronic (7-day) biomonitoring with a critical dilution based on the effluent flow and critical mixing conditions. If a permittee discharges to a perennial stream and the critical dilution is less than 5% effluent, TNRCC will require 48-hour acute toxicity tests. The TNRCC will assign a critical dilution for the 48-hour acute test using a 10:1 acute/chronic ratio. If the TNRCC determines that biomonitoring is required for a stormwater discharge, the staff may use an analysis of the watershed to determine runoff volumes for dilution estimates.

TNRCC will normally require permittees that discharge to a lake to conduct chronic biomonitoring with a critical dilution of 15% if the effluent flow is less than or equal to 10 MGD. If the effluent flow is greater than 10 MGD, TNRCC will use EPA's Jet Plume model to determine the percentage of effluent at the edge of the mixing zone (See "Defining Critical Conditions and Mixing Zones"). The TNRCC will require a more protective (>15%) critical dilution if the mixing zone is less than 100 feet wide. TNRCC will assign a critical dilution of 100% effluent for discharges greater than 100 MGD.

TNRCC will normally require permittees that discharge less than or equal to 10 MGD into bays, estuaries, and wide tidal rivers (\geq 400 feet across) to conduct chronic

toxicity tests with a critical dilution of 8% effluent. If the effluent flow is greater than 10 MGD, TNRCC will use EPA's Jet Plume model to determine the percentage of effluent at the edge of the mixing zone (See "Defining Critical Conditions and Mixing Zones"). Permittees discharging to narrow tidal rivers (< 400 feet across) will receive critical dilutions based on upstream flow whenever flow information is available. In the absence of site-specific data such as dispersion dye studies or nearby flow measurements, the critical dilution typically will not be less than 8% to ensure the same level of protection given to other marine waters. If upstream flows are not available, the Jet Plume model will be used to determine the critical dilution at the edge of the mixing zone. Critical dilutions calculated in this way will be greater than 8% because the mixing zone size will be less than 200 feet. (See "Defining Critical Conditions and Mixing Zones" for more information.)

The permittee must perform a Toxicity Identification Evaluation/Toxicity Reduction Evaluation (TIE/TRE) upon demonstration of persistent lethality to either test species exposed at the critical dilution concentration. Persistent lethality is demonstrated upon confirmation of statistically significant lethality in a retest. Permittees must conduct retests when statistically significant lethality occurs at the critical dilution concentration. The purpose of the TIE/TRE is to determine the cause of toxicity, to determine methods to reduce or eliminate the toxicity, and to develop a schedule for taking corrective action. Components of a TIE/TRE may include:

- chemical analyses;
- effluent characterization test (physical/chemical properties);
- toxicity tests on effluent prior to and after characterization test manipulations;
- toxicity tests on effluent after chemical/physical separations ;
- source identification evaluation;
- instream toxicity tests;
- chemical identification after chemical/physical separations of toxic phase; and
- assessment of treatment technology available to remove the toxic substance from the effluent.

The permit requires the discharger to submit a general outline for performing a TRE within 45 days of the retest that confirms lethality. The outline should describe the preparations the permittee will take to develop and implement a TIE/TRE, and should establish its initiation date. Within 90 days of the retest that confirms lethality, the permit requires the discharger to submit a detailed TIE/TRE plan. The TRE plan should describe the specific approach and methodology the permittee will use during the TIE/TRE and must include schedules for chemical and biological testing, specific activities, a sampling plan, a quality assurance plan, and project

organization. The permittee may modify the TIE/TRE schedule and approach as necessary during the process.

The permittee must implement the TIE/TRE with due diligence and submit quarterly reports to the TNRCC that describe TIE/TRE progress and results. The permit will normally require that the permittee complete the TRE and submit a final report on the activities within 28 months of the retest that confirms lethality. The permittee may petition the Executive Director for an extension to the 28-month time limit. However, the extension must be warranted, and approval is contingent upon the permittee demonstrating due diligence in pursuit of the TIE/TRE and circumstances beyond their ability to control.

The permittee may cease TIE/TRE activities if they demonstrate to the Executive Director that the effluent no longer causes lethality to the test organisms. The permit defines a cessation of lethality as no significant lethality at the critical dilution, using test procedures specified in the permit, for a period of twelve (12) consecutive months. This permit language accommodates situations where operational errors and upsets, spills, or sampling errors triggered the TIE/TRE, which differs from a situation where a single toxicant or group of toxicants cause lethality. When a permittee ceases TIE/TRE activities under this provision, they must continue biomonitoring as required in their permit. This provision is not applicable if the lethality ceases for twelve consecutive months as a result of the permittee taking corrective action. Corrective actions that may eliminate or reduce effluent toxicity could include source reduction or elimination, process changes, housekeeping improvements, changes in chemical use, and/or modification to wastewater treatment.

Near the conclusion of the TIE/TRE and associated corrective measures, the TNRCC may amend the permit to specify toxicity control measures. These may include a chemical specific limit, a whole effluent toxicity (WET) limit, or a Best Management Practice (BMP), along with a reasonable compliance period (30 TAC § 307.6(e)(2)(D)). The TNRCC will use the chemical specific limit in lieu of a WET limit if the chemical specific limit can adequately address toxicity. The permittee must demonstrate that a known toxicant(s) caused the lethality, and should attempt to determine a specific concentration of the toxicant that does not elicit lethality.

The TNRCC will amend the permit to specify a WET limit if a chemical specific limit or a BMP cannot adequately address the lethality. For use in biomonitoring, BMPs are defined as a practice or combination of practices that remove toxicity from the effluent by eliminating the source of toxicity. If successful, the BMP will become an enforceable part of the permit. This would not include situations where toxicity is reduced as a result of housekeeping changes or operational changes. In these cases, the source of toxicity still remains. Multiple toxicants, or lack of a routine test

method capable of detecting a pollutant at levels causing toxicity, are examples of cases where a chemical specific limit may be inadequate to address toxicity. For WET limits, the TNRCC will establish the compliance period and test frequency on a case-by-case basis. Where needed, the TNRCC will normally allow a compliance period for both the chemical specific and WET limits. Total toxicity attributable to diazinon, dissolved salts, or ammonia is discussed in the sections of this document that follow.

100% End-of-Pipe Acute Toxicity Testing

In addition to conducting 48-hour acute or chronic (7-day) toxicity tests, dischargers will be required to conduct 24-hour acute tests using 100% effluent. This end-of-pipe toxicity test measures compliance with 30 TAC § 307.6.(e)(2)(B) of the TSWQS which requires that greater than 50% of the test organisms survive exposure to 100% effluent for 24 hours. The test organisms for each type of test are given below:

Freshwater receiving streams (salinity <2 ppt)

- 24-hour Daphnia pulex (cladoceran crustacean) acute survival test
- 24-hour Pimephales promelas (fathead minnow) acute survival test
- 24-hour Ceriodaphnia dubia (cladoceran crustacean) acute survival test
(Use of this test species is only allowed where the permittee substitutes the results of the 7-day chronic test for this testing requirement as discussed later in "Test Substitution".)

Marine receiving water (salinity ≥2ppt)

- 24-hour Mysidopsis bahia (mysid shrimp) acute survival test
- 24-hour Menidia beryllina (inland silverside) acute survival test
- 24-hour Cyprinodon variegatus (sheepshead minnow) acute survival test
(Generally, permits will no longer require this species. However, instances may exist where the sheepshead minnow is preferable to the inland silverside minnow.)

The TNRCC will require 24-hour toxicity testing of domestic wastewater dischargers: 1) with a daily average permitted flow of 1 MGD or greater, or 2) that have an interim or final phase of their permit with a design flow of 1 MGD or greater during the term of the permit, or 3) that have an approved pretreatment program, or 4) that the staff believe have the potential to exert toxicity in the receiving water. For those permittees that will expand their plant, biomonitoring requirements will begin after expansion to the phase of 1 MGD or greater.

The TNRCC also requires 24-hour toxicity testing of: 1) most EPA-classified major industrial dischargers with continuous-flow outfalls and 2) industrial dischargers with continuous-flow outfalls with the potential for exerting toxicity. The TNRCC will generally not require 24-hour toxicity testing of EPA-classified minor industrial dischargers or once-through cooling water outfalls for industrial facilities. However, the TNRCC may require toxicity testing of once-through cooling water outfalls if: 1) the permittee applies water treatment chemicals or biocides at a frequency and concentration that would raise significant concerns to TNRCC, or 2) TNRCC determines that the effluent has the potential to exert toxicity in the receiving water, or 3) water quality-based permit limits to protect aquatic life are specified for that outfall or 4) other potentially toxic wastestreams are commingled with the once-through cooling water. Water quality-based permit limits to protect aquatic life are numerical limits for one or more specific toxicants derived from the aquatic life criteria in the TSWQS. The TNRCC may require biomonitoring of once-through cooling water outfalls if the intake water and receiving water are different water bodies. The TNRCC may require toxicity testing of EPA-classified minor industrial discharges that the staff determine have the potential to exert toxicity in the receiving water. The TNRCC may require 24-hour acute testing for intermittent process water outfalls and/or storm water outfalls with the potential for exerting toxicity. Dischargers with multiple outfalls will test each outfall that has the potential to exert toxicity. Multiple outfall samples may not be composited.

A permit's 24-hour acute toxicity testing requirements are usually derived from the test results submitted with the application. The applicant conducts the appropriate 24-hour toxicity tests as described in the application. If both tests pass (30 TAC § 307.6.(e)(2)(B)), the applicant will normally be required to conduct 24-hour acute toxicity tests at a frequency of once per six months (as a minimum).

If either application test fails (does not meet the surface water quality standard), the applicant will have the opportunity during the application process to conduct three retests in consecutive weeks for each species that failed. If any of the retests fail, the permittee will be required to initiate a TIE/TRE upon permit issuance. The objective of the TIE/TRE is compliance with 30 TAC § 307.6.(e)(2)(B). If all retests pass, the applicant will be required to conduct 24-hour acute toxicity tests at an increased frequency of once per quarter to once per month for the species that initially failed, and once per six months for the species that passed.

A failing 24-hour acute toxicity test performed to meet permit requirements necessitates two retests in consecutive weeks. If both retests pass, the permittee continues testing at the permit-designated frequency. If one or both of the retests fail, the permittee will be required to initiate a TIE/TRE.

Upon initiation of a TIE/TRE, the permit requires compliance with 30 TAC § 307.6.(e)(2)(B) within 3 years of the test that confirmed toxicity (the failing retest). The permittee may petition the Executive Director for an extension to the 3-year limit. However, the extension must be warranted and is contingent upon the permittee demonstrating due diligence in pursuit of the TIE/TRE and circumstances beyond their ability to control.

Near the third year's end, the TNRCC will amend the permit to include a chemical-specific limit, a BMP, or a Whole Effluent Toxicity (WET) limit. A chemical-specific limit or a BMP must adequately address the effluent's toxicity. If not, the TNRCC will specify a WET limit. The WET limit enforces the 30 TAC § 307.6.(e)(2)(B) requirement for greater than 50% survival in 100% effluent after 24 hours of exposure.

With two primary exceptions, the TIE/TRE requirements are similar to those discussed in the Chronic and 48-Hour Whole Effluent Toxicity Testing section of this document. Since the permittee should normally comply with 30 TAC § 307.6(e)(2)(B) within three years, the permit specifies completion of the TRE and submission of a final TRE report within 18 months of the failed retest. The permittee may petition the Executive Director in writing for an extension to the 18-month time limit. However, the extension must be warranted and is contingent upon the permittee demonstrating due diligence in pursuit of the TIE/TRE and circumstances beyond their ability to control. The permit also specifies that the TIE/TRE continue unless the permittee demonstrates to the Executive Director that the effluent has ceased to induce lethality. The permit defines a cessation of lethality as greater than 50% survival after 24 hours of exposure to 100% effluent for twelve (12) consecutive weeks with at least weekly sampling and testing. Lethality attributable to diazinon, dissolved salts, or ammonia, is discussed in the following sections.

Test Substitution

The TNRCC will normally require permittees to conduct the 48-hour acute or 7-day chronic toxicity tests, and the 100% end-of-pipe acute toxicity tests as separate requirements in permits. If the 48-hour acute or 7-day chronic toxicity tests include a 100% effluent in the dilution series, the permit will allow the results from those tests (after 24 hours of exposure), to fulfill the requirements in the 100% end-of-pipe acute tests. The permittees will then report the survival of organisms in the 100% effluent concentrations after 24 hours. The permit will stipulate that the 100% end-of-pipe acute toxicity testing provision applies whether or not the tests results are submitted for this requirement, the 48-hour acute, or 7-day chronic requirements. The permittee may add a 100% effluent dilution to 7-day chronic tests, and submit the results after 24 hours to fulfill the 24-hour acute testing requirements.

Toxicity Attributable to Dissolved Salts

A permittee may be exempt from compliance with the Total Toxicity provisions in the TSWQS if they demonstrate that dissolved salts caused the effluent to be toxic. This exemption is allowed under the definition of toxicity in the TSWQS and under the 100% end-of-pipe acute toxicity provisions (30 TAC § 307.6(e)(2)(B)).

The definition of toxicity in the TSWQS excludes adverse effects caused by concentrations of dissolved salts when the salts originate in a permittee's source water. This exemption would affect compliance with the 48-hour and chronic toxicity testing provisions. The TSWQS define "source water" as "surface water or groundwater that is used as a public water supply or as an industrial water supply (including cooling water supply)." The TSWQS also state that the source water "does not include brine water that is produced during the extraction of oil and gas, or other sources of brine water that are substantially uncharacteristic of surface waters in the area of the discharge."

Also, acute (24-hour) toxicity caused by concentrations of dissolved salts that originate from the source water, or toxicity caused by an excess, deficiency, or imbalance of dissolved salts in the effluent are exempted from compliance with the 100% end-of-pipe acute toxicity provision. These exemptions specified in 307.6 (e)(2)(B) do not include instances where individually toxic components (for example, the pollutants listed in Table 1 of the TSWQS) have formed a salt compound that is causing the effluent to be toxic. Figure 6 outlines the steps in proving that dissolved salts are responsible for the toxicity and receiving the exemption. The following sections further explain the exemptions for dissolved salts.

****100% End-of-Pipe Acute Tests****

When a permittee believes they are failing their 24-hour acute tests because of dissolved salts, they must first show that dissolved salts are a cause of toxicity in their effluent. Because the effluent may have multiple toxicants, the permittee must then prove that dissolved salts are the primary cause of toxicity. The following paragraphs describe the process in more detail.

To confirm that dissolved salts are a cause of toxicity in the effluent, the permittee must conduct at least one set of TIE/TRE characterization tests including an ion-exchange procedure. If the TIE/TRE tests fail to prove that dissolved salts are a cause of toxicity, the permittee must continue with the TIE/TRE to identify the toxicant(s) and to reduce or eliminate the acute toxicity. If the TIE/TRE tests show that dissolved salts are a cause of toxicity in the effluent, the permittee must then prove that they are the primary cause of acute toxicity.

The permittee should use a combination of the following techniques to show that dissolved salts are the primary cause of acute toxicity:

- 1) conduct toxicity tests using an alternate species that is more tolerant of dissolved salts;
- 2) conduct side-by-side toxicity tests using the toxic effluent as well as a mock effluent formulated to mimic the ionic composition of the effluent;
- 3) perform measurements of high levels of dissolved salts in the effluent;
- 4) perform an analysis of the ionic components of the dissolved salts;
- 5) use computer models that predict the acute toxicity of saline waters; or
- 6) perform effluent toxicity tests using sea salts that are formulated to correct ionic imbalances.

The permittee may suggest other methods to demonstrate that dissolved salts are the primary cause of toxicity for the TNRCC's review and consideration.

If these techniques show that dissolved salts are not the primary cause of acute toxicity, the permittee must continue with the TIE/TRE to address the toxicity. If the techniques prove that dissolved salts are the primary cause of toxicity, the TIE/TRE requirements will cease.

When the TIE/TRE requirements cease because dissolved salts are the primary source of acute toxicity, TNRCC staff will evaluate or require the permittee to evaluate the use of an alternative test species or modified test protocol. The permittee may be required to continue conducting the 24-hour acute tests if an alternate test protocol successfully resolves the acute toxicity caused by the dissolved salts in the effluent. The TNRCC will initiate an amendment of the permit to include these measures. If an alternate species is unavailable, or if test protocol modifications such as ionic adjustments are unsuccessful, the permittee will most likely be required to continue testing with the standard test species that is unaffected by the dissolved salts.

****48-Hour Acute and Chronic Tests****

When a permittee believes effluent toxicity evidenced by a 48-hour acute or chronic toxicity test is caused by dissolved salts, the permittee must follow an approach similar to that described in the previous section. First, the permittee should show that dissolved salts are a cause of toxicity in the effluent. Since the effluent may contain multiple toxicants, the permittee must then prove that dissolved salts are the primary source of toxicity. Next, the permittee must show that the dissolved salts are coming from their source water. Finally, the permittee must show that their effluent will not impair aquatic life uses in the receiving waters. The permittee must complete

each step in this process to receive the exemption for dissolved salts. The following paragraphs describe this process in more detail.

To confirm that dissolved salts are a cause of effluent toxicity, the permittee must conduct at least one set of TIE/TRE characterization tests including an ion-exchange procedure. If the TIE/TRE tests show that dissolved salts are not a cause of effluent toxicity, the permittee must continue with the TIE/TRE to identify the toxicant(s) and to reduce or eliminate the toxicity.

If the TIE/TRE tests show that dissolved salts are a cause of effluent toxicity, the permittee must then prove that they are the primary cause of toxicity.

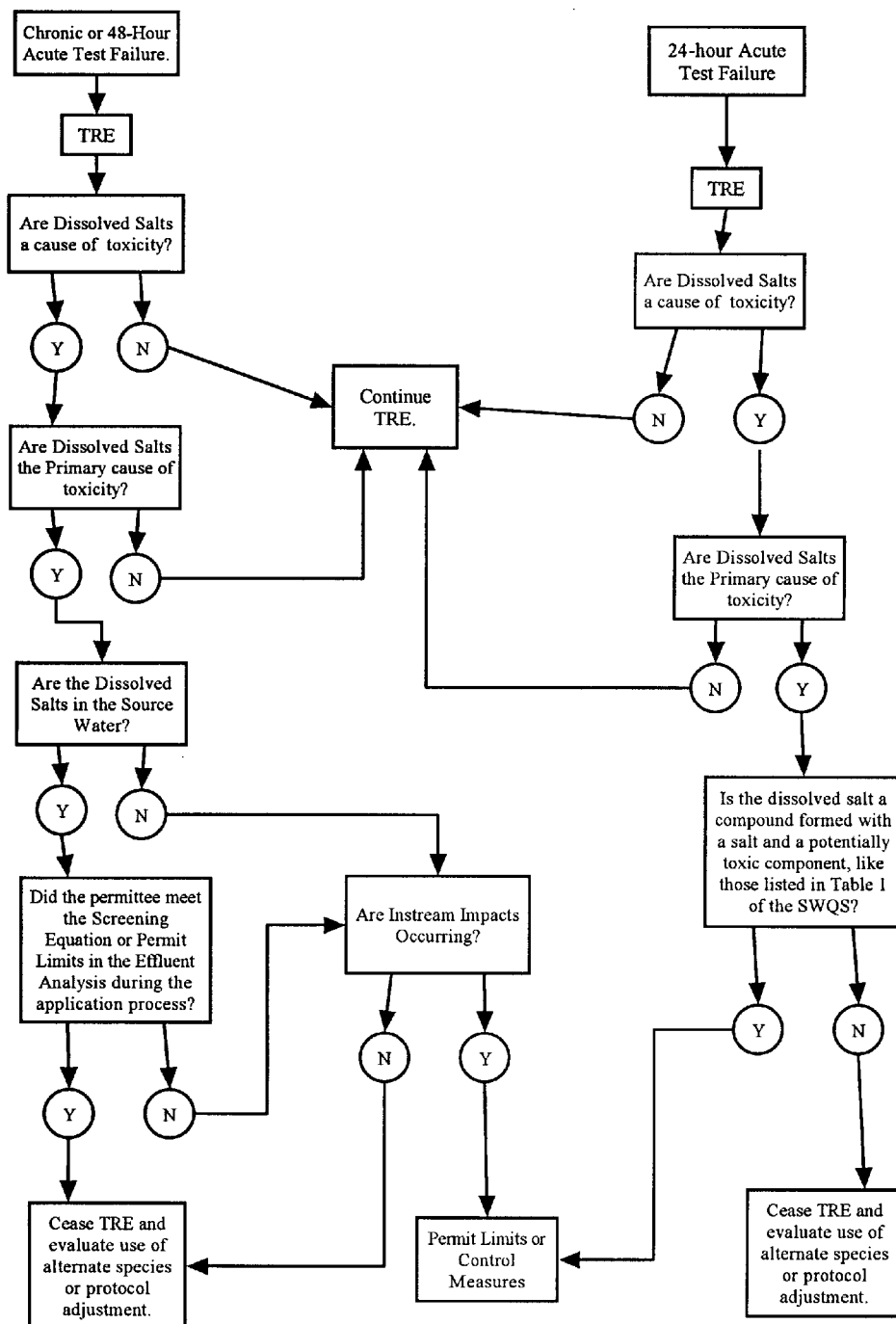
The permittee may use the techniques described earlier (in the discussion of the 100% end-of-pipe tests) to prove that dissolved salts are the primary cause of toxicity. If these techniques fail to show this, the permittee must continue with the TIE/TRE to address the toxicity. If the techniques prove that dissolved salts are the primary cause of toxicity, the permittee must then prove that the dissolved salts are coming from their source water.

To help prove that the dissolved salts are coming from their source water, the permittee should sample the facility's intake water and/or raw water source and compare its dissolved salt concentrations and ionic composition with that of the effluent. Increases in the dissolved salt content of the effluent due to process evaporation should also be evaluated.

If the dissolved salts are not from the source water, the permittee must comply with the Total Toxicity provisions. The permittee may choose to conduct a biological study to evaluate the receiving water for instream impacts. To do this, the permittee must follow the guidelines for the biological study in the "Calculation of Total Dissolved Solids Permit Limits" section of this document. If receiving water impacts are occurring, the permittee must comply with the Total Toxicity provisions, and is subject to permit limits or control measures. If receiving water impacts are not occurring, the permittee may cease their TRE.

If the dissolved salts are from the source water, the TNRCC will use the results of the permittee's screening equation to determine if instream impacts are occurring. This procedure is conducted as part of the application phase of the permit process, and is described in the "Calculation of Total Dissolved Solids Permit Limits" section of this document. If this procedure shows a potential for instream impacts and a biological study confirms it, the permittee must comply with Total Toxicity provisions, and is subject to permit limits or control measures. If this procedure does not indicate a potential for instream impacts, the permittee may cease the TRE. Discharges to marine waters will be reviewed on a case-by-case basis.

Figure 6. Procedure for Exemption from Total Toxicity Requirements Because of Dissolved Salts



If the TIE/TRE requirements cease because dissolved salts are causing the toxicity, TNRCC staff may require the permittee to evaluate the use of an alternative test species or modified test protocol. The permittee may be required to continue testing if modifying the test protocol or use of an alternate species resolves the toxic effect of the dissolved salts in the effluent. The TNRCC will then amend the permit to include these measures. If an alternate species is unavailable or tests using a modified test protocol still demonstrate toxicity due to dissolved salts, the permittee will most likely be required to continue testing with the standard test species that is unaffected by the dissolved salts.

Freshwater Toxicity Attributable to Ammonia

The TNRCC recognizes that a technology-based ammonia-nitrogen limit of 3 mg/l generally precludes toxicity to freshwater test species, specifically the fathead minnow. Therefore, the TNRCC will accept this limit as the TRE resolution for toxicity attributable to ammonia. This resolution applies solely to municipal treatment plants discharging to freshwater with ammonia as the primary toxicant.

Such a limit will normally be in lieu of a WET limit or some other corrective action. However, should compliance with a 3 mg/l ammonia-nitrogen limit prove ineffective in precluding fathead minnow toxicity, TNRCC staff will amend the permit to include an alternative limit and/or corrective measures protective of the receiving waters.

For those facilities with an Interim or Final Effluent Phase that includes a 3 mg/l ammonia-nitrogen limit, the persistent lethality requirements will be suspended until the effective date of the limit. For those facilities without an Interim or Final Effluent Phase that includes a 3 mg/l ammonia-nitrogen limit, TNRCC staff will amend the permit to include a limit. Facilities with an Interim or Final Effluent Phase that includes seasonal ammonia-nitrogen limits or ammonia-nitrogen limits greater than 3 mg/l will be evaluated by TNRCC staff on a case-by-case basis for the appropriateness of the specified limit; if the limit appears incapable of precluding fathead minnow toxicity, TNRCC staff will amend the permit to include an ammonia-nitrogen limit of 3 mg/l.

Toxicity Attributed to Diazinon

The TSWQS contain a special provision (30 TAC § 307.6.(e)(2)(E)) for those municipal facilities demonstrating diazinon as the primary cause of total toxicity within the collection system. Upon demonstrating such, using standard TIE/TRE characterization tests and other analytical techniques, and upon demonstrating that diazinon is ubiquitous within the wastewater collection system, TNRCC will amend

the municipality's permit. The amendment will require the permittee to address toxicity in the following manner:

- 1) Public Education Program (PEP) The permittee shall implement a PEP, emphasizing education and awareness to prevent diazinon from entering the collection system. The PEP should include, but not be limited to, the following components:
 - a. Users Survey - The permittee will survey all suspected users of diazinon. The survey will be comprehensive, including individuals as well as businesses. The survey should identify those source groups and/or individuals that should receive the information described in (b).
 - b. Information Development - The permittee should develop information for dissemination to source groups and individuals. This information should include best management practices for use of diazinon and other pesticides, and alternative methods of pest control besides the use of organophosphate pesticides.
 - c. Dissemination of Information - The targeted audience should be assured of receiving the developed information through a number of means, including the media, mailings, and public presentations.
- 2) Diazinon Monitoring The permittee will monitor wastewater influent and effluent for diazinon while continuing to biomonitor using the most sensitive species. The results of the biomonitoring and the diazinon monitoring will be submitted in quarterly reports.

Should diazinon not prove to be the primary cause of toxicity or not be ubiquitous within the wastewater collection system, the permittee shall resume the TRE. In addition, should the permittee not address diazinon toxicity as described above with due diligence, the TRE requirements remain in effect. In either case, the TNRCC may amend the permit to specify appropriate toxicity control measures as given in 30 TAC § 307.6.(e)(2)(D).

Defining Critical Conditions and Mixing Zones

This section describes how the TNRCC assigns mixing zones and zones of initial dilution (ZIDs) and their associated critical mixing conditions for discharges into different types of water bodies. For all domestic permits with a flow of 1 MGD or greater (and for any other permit where numerical criteria and/or toxicity tests have

been specifically expressed as permit limitations) and industrial permits (excepting discharges which consist entirely of stormwater runoff), the critical conditions and the mixing zones shall be defined in the permit. The mixing zone may not encompass an intake for a domestic drinking water supply that includes an organized treatment system as defined in 30 TAC § 290.

Mixing Zones and Critical Conditions for Aquatic Life Protection

Mixing zone size and shape may be varied in individual permits to account for differences in: 1) stream flow; 2) bay, estuary, and reservoir morphometry; 3) effluent flow; 4) stream geometry; 5) ecological sensitivity at the discharge site; 6) zone of passage concerns; and 7) discharge structures. Mixing zones for discharges into perennial streams or rivers will be expressed in the permit in terms of longitudinal stream distance. The typical mixing zone will extend 300 feet downstream and 100 feet upstream from the discharge point. Mixing zones shall not preclude passage of free swimming or drifting aquatic organisms to the extent that aquatic life use is significantly affected. ZIDs, although not specified in permits, may not exceed a size of 60 feet downstream and 20 feet upstream from the point of discharge. ZIDs shall not encompass more than 25% of the volume of the stream flow at or above 7Q2 low flow conditions. ZIDs cannot extend across perennial streams or rivers or impair migration of aquatic organisms.

Complete mixing of effluent and ambient instream flows will be assumed at mixing zone boundaries for discharges into perennial streams and rivers. Effluent concentration limits for specific toxic materials will be calculated for chronic numerical toxic criteria by using instream dilution at 7Q2 stream flows as described in the section entitled "Deriving Permit Limits for Aquatic Life Protection". The proportion of effluent instream at 7Q2 stream flows will also be used as the primary concentration (critical dilution) for chronic total toxicity testing. When applying acute numerical criteria, instream concentrations will be calculated at 1Q2 stream flows. (1Q2 flows may be estimated as 25% of 7Q2 flows.) For intermittent streams as defined in 30 TAC § 307, where there are no significant aquatic life uses, acute criteria will apply at the point of discharge and no dilution will be assumed.

Mixing zones for discharges into lakes and reservoirs will normally be expressed in the permit as a maximum radius that extends over the receiving water in all directions from the point of discharge. The typical mixing zone radius will be 100 feet. ZIDs, although not specified in permits, may not exceed a 25-foot radius in all directions (or equivalent volume or area for diffuser systems) from the point of discharge. This is generally equivalent to 6.3% of the mixing zone surface area.

Mixing zones for discharges into bays, estuaries and wide tidal rivers (≥ 400 feet across) will be expressed in the permit as a maximum radius that extends over the receiving water in all directions. The typical mixing zone radius will be 200 feet. ZIDs, although not specified in permits, may not exceed a 50-foot radius in all directions (or equivalent volume or area for diffuser systems) from the point of discharge. In all cases, the mixing zone radius for discharge plume analysis should typically be less than one-half the receiving water width at the discharge point.

Critical conditions at mixing zone boundaries for discharges into lakes, reservoirs, bays, estuaries, and wide tidal rivers will be estimated from appropriate models of discharge plume dispersion. Currently, the TNRCC is using EPA's horizontal Jet Plume model (see Fischer et al., 1979, Mixing in Inland and Coastal Waters, Section 9.2.1, p. 328) to estimate dilution. Model results and empirical data indicate that the following initial assumptions are appropriate for discharges of less than or equal to 10 MGD: 1) the percentage of effluent at the boundary of the mixing zone is 15% for lakes and 8% for bays, estuaries, and wide tidal rivers and 2) the percentage of effluent at the boundary of the ZID is 60% for lakes and 30% for bays, estuaries, and wide tidal rivers. These assumed critical dilutions are based on the standard mixing zone sizes of 100 feet (lakes and reservoirs) and 200 feet (bays, estuaries, and wide tidal rivers). If it is necessary to assign a smaller mixing zone, these effluent percentages will increase. TNRCC staff may use data from appropriately performed effluent dispersion dye studies to vary from the conservative initial dilution assumptions. Effluent concentration limits for specific toxic materials will be initially calculated to meet chronic numeric toxicity standards at the mixing zone boundary and acute numeric toxicity standards at the edge of the ZID. The estimated concentration at the mixing zone boundary will also be used as the primary concentration for chronic total toxicity testing.

Critical conditions at mixing zone boundaries for discharges into narrow tidal rivers (< 400 feet across) will be calculated as for perennial streams and rivers if upstream flow data from USGS gauges or other sources are available. The typical mixing zone will extend 300 feet downstream and 100 feet upstream from the discharge point. In the absence of site-specific data such as dispersion dye studies or nearby flow measurements, minimum critical dilutions of 8% effluent at the edge of the mixing zone and 30% effluent at the edge of the ZID will be assumed. Because mixing conditions in tidal rivers with upstream flow are not well understood, these minimum dilutions should provide narrow tidal rivers with the same level of protection given to bays, estuaries, and wide tidal rivers. If upstream flow data from USGS gauges or other sources is unavailable, the horizontal Jet Plume model will be used to calculate critical conditions. In these cases, the mixing zone radius will be one-half the width of the narrow tidal river at the discharge point, and the critical dilutions will be greater than 8% at the edge of the mixing zone, and greater than 30% at the

edge of the ZID. TNRCC staff may also consider tracer analyses, empirical data, or other models to determine site-specific instream dilution in narrow tidal rivers.

Mixing Zones and Critical Conditions for Human Health Protection

Mixing zones for human health protection for discharges into perennial streams or rivers are the same size as those for aquatic life protection. Human health criteria must be met at the edge of the mixing zone using the harmonic mean flow to calculate the proportion of effluent present. Mixing zones for lakes will typically extend 200 feet in all directions over the receiving water from the point of discharge. At this distance, the assumed critical dilution for discharges of less than or equal to 10 MGD will be 8%. Mixing zones for bays, estuaries, and wide tidal rivers will typically extend 400 feet in all directions over the receiving water from the point of discharge. At this distance, the assumed critical dilution for discharges of less than or equal to 10 MGD will be 4%. The staff may use the results of appropriately performed effluent dispersion dye studies to vary from these assumptions.

In narrow tidal rivers, the critical conditions for human health protection will be calculated as for perennial streams and rivers if upstream flow data from USGS gauges or other sources are available. In this case, the mixing zone is the same size as that for aquatic life protection. In the absence of site-specific data such as dispersion dye studies or nearby flow measurements, a minimum critical dilution of 4% effluent at the edge of the mixing zone will be assumed. Because mixing conditions in tidal rivers with upstream flow are not well understood, this minimum dilution should provide narrow tidal rivers with the same level of protection given to bays, estuaries, and wide tidal rivers. If upstream flow data from USGS gauges or other sources is unavailable, the horizontal Jet Plume model will be used to calculate the critical dilution. In these cases, the mixing zone radius will be equal to the width of the river at the discharge point, and the critical dilution will be greater than 4% at the edge of the mixing zone. More protective human health critical conditions may be used where bioaccumulative or persistent pollutants are a concern. TNRCC staff may also consider tracer analyses, empirical data, or other models to determine site-specific instream dilution in narrow tidal rivers.

Harmonic Mean Flow

The harmonic mean flow of a water course is used to determine specific numeric requirements for human health protection. The harmonic mean flow in a water course is calculated by summing the reciprocals of the individual flow measurements, dividing this sum by the number of measurements, and calculating the reciprocal of this quotient.

$$HARMONIC\ MEAN\ FLOW = \left(\frac{\sum_{i=1}^N X_i^{-1}}{N} \right)^{-1}$$

N = number of flow measurements

SITE-SPECIFIC STANDARDS AND VARIANCES

General

The narrative provisions, the designated uses, and the numerical criteria of the TSWQS may be amended to account for local conditions (30 TAC § 307.2(d)(3)).

Adoption of a site-specific standard is an explicit amendment to the TSWQS that requires EPA approval and an opportunity for public hearing. In cases with "site complications" that require substantial additional time to justify, review, and approve a site-specific standard, a temporary variance for an existing facility may be requested prior to or during the permit application process to allow the permittee time to gather information to support a standards change. A temporary variance is not equivalent to a site-specific standard. Preliminary evidence that indicates that a site-specific standards amendment may be appropriate should be submitted to the TNRCC to show that a temporary variance is warranted. Temporary variance procedures are defined in 30 TAC § 307.2(d)(4) of the TSWQS. The information necessary to justify a variance is simply a piece of the standards amendment justification process. With time, the applicant must cultivate a more comprehensive data base to support the standards amendment. Technical guidance to support a standards amendment is given in the following sections of this document: 1) Aquatic Life Use Site-Specific Standards; 2) Site-Specific Numeric Aquatic Life Standards; and 3) Site-Specific Total Toxicity Standards.

The temporary variance request must be included with a permit application public notice and is subject to a public hearing. The temporary variance must be approved by the TNRCC before issuance of the associated final permit. A temporary variance for an NPDES permit will also require EPA approval. The Commission's approval of a variance formally recognizes that a site-specific standard may be justified based

on preliminary evidence provided by the applicant, whereas a standards amendment is a rule change. If the variance is approved by the Commission, the associated permit (normally considered at the same Commission agenda) will provide interim permit limits for up to three years based on the variance approval. The final permit limits will define requirements necessary to comply with the existing standards.

The interim phase of the permit allows the applicant time to gather information necessary to fully support a site-specific standard. With this information, the applicant should formally petition the Commission for the site-specific standard before the interim phase of the permit has lapsed. If the standards amendment is approved by the Commission (and EPA), the discharge permit will be amended to reflect the new standards. If the Commission (and EPA) does not approve the standards amendment, the permit may be amended (if necessary) to allow the permittee up to 3 additional years to achieve compliance with the final permit limits based on the existing standards (30 TAC § 307.2(f)).

If an applicant obtains a variance approval, the process effectively provides up to six years (interim 3 years + additional 3 years) to achieve compliance with the existing standards. In contrast, where a permittee does not pursue the formal variance process, the final permit limits calculated to meet the TSWQS must be achieved within the time frame specified in the permit (maximum of three years). A permittee may also request a variance where an existing permit defines a compliance period to meet the TSWQS. In this case, the existing permit (which defines a compliance period for the pollutant of concern) must be amended to recognize the variance request. If granted, the variance shall expire no later than three (3) years following the issue date for the permit that previously specified a compliance period. An interim limit may be extended to allow additional time for a site-specific standard to be adopted in 30 TAC § 307. This extension can be granted only after a site-specific study that supports a standards change has been completed.

For example, a permit issued on March 1, 1992, may have defined interim and final limits for copper. In this hypothetical permit, the final limits (effective on March 1, 1994) were necessary to comply with the standards. After some research, the permittee concluded that the copper in the effluent was not bioavailable because of local water chemistry. For this reason, the permittee requested a permit amendment to recognize a variance from standards. This would allow the permittee more time to justify a site-specific standard for copper. As a result of the variance request, the newly amended permit specified interim and final limits for copper with the final limits effective on March 1, 1995. In this example, if the standards amendment is approved (prior to March 1, 1995), the discharge permit will be amended again to reflect the new standards. If the Commission does not approve the standards amendment, the hypothetical permit may be amended (if necessary) to allow the permittee up to three

years to achieve compliance with the final permit limits based on the existing standards.

The application of a temporary variance or site-specific standard must not impair an existing, attainable or designated use.

Site-Specific Standards for Aquatic Life Use

The following procedure will be used to conduct use-attainability analyses, to lower aquatic life uses on classified streams, and to establish site-specific standards modifications to presumed aquatic life uses for unclassified perennial streams. For unclassified waterbodies, aquatic life uses are assessed as described in the previous section entitled "Determination of Water Quality Uses and Criteria." In cases where the preliminary assessment indicates that the attainable aquatic life use for a particular unclassified waterbody might be lower than the presumed aquatic life uses, a use-attainability analysis is conducted in accordance with the following procedures. Use-attainability analyses are also conducted on classified streams where the attainable aquatic life use has become lower than the designated use.

General Procedure

The permittee will be responsible for conducting the use-attainability analysis. TNRCC staff will review each use-attainability analysis in order to assure conformance with the basic protocol. If a lower aquatic life use designation is justified, then TNRCC staff will forward the use-attainability analysis to EPA Region VI for review and preliminary approval.

Within 30 days after receiving a use-attainability analysis for a "typical site" on an unclassified stream, EPA will review the use-attainability analysis in accordance with this protocol and provide a response to the TNRCC. Additional time may be needed for EPA review of streams with "site complications." Preliminary approval of a use-attainability analysis by EPA will constitute a finding that the requested aquatic life uses and criteria for the stream are "approvable" for a site-specific designation in the TSWQS.

Site-specific aquatic life uses will be designated in the standards as a result of any standards revision. To the extent possible, the public notification and public hearing requirements for adopting a site-specific standard may be conducted in conjunction with the public participation procedures for any permit actions that affect the particular site.

After TNRCC and EPA final approval of the standards change, state and federal discharge permits will be issued with effluent limits based upon the new site-specific standard designation. The new site-specific standard will also be included in the TNRCC Water Quality Management Plan.

For classified streams, EPA may need more than 30 days to review the use-attainability analysis. Lowering a designated aquatic life use on a classified waterbody takes a more extensive study than a study on an unclassified stream. As with unclassified streams, the permittee is responsible for conducting the use-attainability assessment. An analysis for a classified stream requires that representative sites throughout the segment be evaluated rather than one typical site as for an unclassified stream. TNRCC will review the analysis to ensure conformance with basic protocol. If the analysis indicates that the attainable use is lower than the designated use, TNRCC will forward the analysis to EPA. EPA will review the analysis and forward a response to TNRCC. Preliminary approval of a use-attainability analysis by EPA for classified streams will constitute a finding that the lowered aquatic life use is "approved" as the new designated use for the classified stream. The change in the designated use will be placed in the next revision of the TSWQS. The following sections discuss use-attainability requirements.

Use-Attainability Analysis for Typical Sites

A. Applicability

1. A sample site unimpacted by a pollutant source is available (or data already exists for a reference area), such as in the projected area of impact for a new permit, or upstream of an existing permit.
2. The attainable use is not impaired by other sources of pollution at critical conditions.
3. The characteristic aquatic life use in unimpacted reference areas is lower than the statewide or region wide presumed use. This corresponds to one or more of the following reasons for downgrade listed in 40 CFR 131:
 - a. Naturally occurring poor water quality prevents the attainment of the use.
 - b. Natural stream flow conditions prevent the attainment of the use.

- c. Physical characteristics of the stream channel (morphometry) preclude attainment of aquatic life uses.
- d. Hydrologic modifications (dams, spillways, intake structures, etc.) preclude the attainment of the use, and the impacts cannot be reasonably mitigated.

B. Summary of Use-Attainability Procedures

1. Identify reference areas and define stream reach(es) to be included in the assessment.
2. Stream morphometry, flow characteristics, and habitat characteristics in the reference area are summarized in accordance with a standardized stream characteristics form (from TNRCC permit application), which also contains a description of the proposed or existing discharge.
3. Fish sampling (or in some cases macroinvertebrate sampling) is conducted in the reference area in accordance with "Texas Water Commission Permit Site Assessment Instruction Manual, December 1988."
4. Quantitative indices are applied in accordance with "Criteria for Assessing Aquatic Life Uses, August 1988."
5. Results are transmitted to EPA by the TNRCC as a summary report with presentation of results on a standardized receiving water assessment form, (TWC-0545A, included as Attachment 6 in the "Texas Water Commission Permit Site Assessment Instruction Manual", December 1988).

Site Complications Requiring Additional Justification

In unusual situations, there may be site-specific complications that indicate more information is needed to justify an aquatic life use which is less than the presumed use for an unclassified waterbody. Examples of such situations and the types of additional information that may be appropriate are listed below.

A. Examples of Site-Specific Complications:

1. The reasonably attainable uses in the receiving waters are impacted by an existing discharge and are considered to be lower than the naturally occurring uses in an appropriate reference area (e.g., upstream).
2. No suitable reference areas are available for sampling.
3. Dissolved oxygen criteria for a particular aquatic life use are inappropriate for the site.

B. Examples of Additional Analyses (as appropriate):

1. Water quality modeling simulations to evaluate treatment options.
2. Additional investigation of pollutant sources and instream impacts.
3. Sampling and evaluation of additional parameters, such as diurnal measurements of dissolved oxygen.
4. Technical and economic feasibility of attaining the presumed use.

Site-Specific Numeric Aquatic Life Standards

A permittee may pursue a standards modification where local site-specific factors suggest that the numerical criteria are inappropriate for a particular water body. These factors are defined in 30 TAC § 307.6(c)(9).

The following paragraphs discuss the information necessary to support these factors. Such information must be submitted as part of a permit application. A permittee may seek a permit amendment based upon these factors to modify final effluent limits. An application to amend a permit does not delay the effective date of final effluent limits as established in an existing permit; therefore, an amendment application must be received well in advance of the effective date of the final effluent limits to allow full Commission consideration and final decision. The remainder of this section discusses each factor and how the TNRCC staff will evaluate information submitted by a permit applicant.

Where an applicant believes that a metal standard is inappropriate, the applicant should carefully evaluate recent effluent analytical data to ensure that effluent metal(s) concentrations do in fact exceed levels necessary to comply with existing standards. The applicant should employ clean techniques for all sample-handling and analytical procedures to avoid sample contamination.

Background concentrations of specific toxics of concern in unimpacted receiving waters, sediment, and/or indigenous biota (307.6(c)(9)(A))

Through sampling of the receiving water in an area unimpacted by dischargers, the applicant must demonstrate that toxic substances exist naturally at concentrations higher than the instream criteria. Where the background concentration is greater than the instream criteria, the TNRCC will establish effluent limitations that will preclude an increase in the background concentration.

Persistence and degradation rate of specific toxic materials (307.6(c)(9)(B))

The applicant may demonstrate that a specific toxic substance in the effluent has a short half-life within the defined mixing zone of the receiving water due to chemical reactions with naturally occurring compounds, degradation in ultra-violet light, and so forth. This demonstration must be made using receiving water while simulating natural conditions as much as possible. The applicant may also use instream studies of existing discharges. The applicant must provide proof of degradation and determine that receiving water concentrations of the toxic substances of concern do not exceed appropriate criteria. In addition, the applicant should determine the worst-case scenario or demonstrate that the degradation rate is independent of seasonal fluctuations in water chemistry (e.g., temperature, pH, dissolved oxygen, and hardness).

Synergistic, additive, or antagonistic interactions of toxic substances with other toxic or nontoxic materials (307.6(c)(9)(C))

A synergistic interaction is a situation in which the combined effect of two or more chemicals is greater than the sum of the effect of each substance alone. An additive interaction is a situation in which the toxicity of a mixture of chemicals is approximately the same as that expected from a simple summation of the known toxicity of each of the individual chemicals in the mixture. An antagonistic interaction is a situation in which a mixture of toxicants exhibits a less-than-additive toxic effect. The applicant may demonstrate that toxicity in an effluent is caused by a synergistic, antagonistic, or related interaction. By modifying the concentration of a certain chemical in the effluent, the applicant may be able to show that a reduction of effluent toxicity will result without the removal of other suspected toxicants. This demonstration must be made by performing biomonitoring tests on effluent or in-situ,

either from a working wastewater treatment system or a pilot project, using receiving waters. Alternatively, a synergistic interaction may necessitate stricter permit limits to protect the receiving waters.

Measurements of total effluent toxicity (307.6(c)(9)(D))

To demonstrate that a site-specific standard may be appropriate, an applicant may perform toxicity tests using indigenous receiving water species. The toxicity tests should be conducted prior to the permit application. The applicant must conduct an assessment of the receiving water to determine the species present. A diverse, representative, and sensitive group of species shall be tested for short- and long-term impacts. The permittee must also demonstrate that sensitive, indigenous species will not be adversely affected, and aquatic life and other uses will not be impaired. Effluent limits based on specific numerical criteria may not be raised if bioaccumulation or persistence in the food chain or the environment may produce long term impacts that can not be measured by total toxicity tests.

Indigenous aquatic organisms, which may have different responses to particular toxic materials (307.6(c)(9)(E))

An applicant may demonstrate that indigenous aquatic organisms are not affected by the effluent at the same concentration as species used to develop the criteria in the standards. This may be accomplished by performing a detailed survey of aquatic organisms in the water body in areas in and out of the effluent plume. The applicant should also prepare a statistical analysis of the impacts to the receiving water. In addition, the applicant should evaluate the relative sensitivities of indigenous organisms to particular toxicants of concern. If the assemblage of indigenous aquatic organisms satisfies the minimum family and genus totals defined in "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" by the U.S. Environmental Protection Agency, Office of Research and Development, NTIS Accession Number PB85-227049, (Stephan et al), the permittee may calculate a site-specific criterion using this EPA guidance.

Technological or economic limits of treatability for specific toxic materials (307.6(c)(9)(F))

If the permittee cannot achieve the required effluent limits (normally no lower than the MAL), by best available technology (BAT), then the permittee may apply for a modification of the effluent limit. An applicant seeking an effluent limit modification due to treatment technology limitations must demonstrate, through the use of pilot

tests, the level to which the specific toxic of concern can be treated using state-of-the-art treatment.

The permittee shall submit an evaluation of the costs of treatment required to meet the water-quality based effluent limit and include a comparison of BAT or existing costs with estimated costs of state-of-the-art treatment. In this evaluation, the applicant should outline the incremental changes to the existing wastewater treatment facility to achieve state-of-the-art treatment. These changes might include alterations in raw materials, manufacturing processes, products produced, and energy requirements. Also, the applicant should demonstrate that improvements in best management practices or a simple raw material substitution would not achieve the treatment level required to meet the water-quality based effluent limits.

The applicant must show that existing or designated receiving water quality uses are not impaired due to the modified permit limits.

Bioavailability of specific toxic substances of concern (307.6(c)(9)(G))

The applicant may demonstrate that the chemical species of a particular substance in the effluent does not induce toxic effects, or has a much less toxic effect than another species of that substance. The applicant must prove that the species present in the effluent does not convert chemically or biologically to a more toxic form upon entering and mixing with receiving waters. If the demonstration is successful, the permit limit may be established based on the combined toxicity of the chemical species in the effluent. Alternatively, if a toxic substance in an effluent converts chemically or biologically to a more toxic species upon entering or mixing with receiving waters, then the permit limit may be established based upon the toxicity of the more toxic chemical species. The applicant may wish to use a water-effect ratio (WER) to adjust the standard when a permit limit for an aquatic life standard is proposed. After a WER is determined for a defined site, the site-specific aquatic life standard can be calculated by multiplying the appropriate state standard by the WER. The TNRCC will generally follow the latest guidance manual published by the EPA: "Interim Guidance on Determination and Use of Water - Effect Ratios for Metals (EPA -823-B-94-001)". WERs obtained using the methods described in this guidance manual can not be used to adjust aquatic life criteria that were derived for metals in other ways. Therefore, WER's using these methods cannot be used to adjust the residue-based mercury Criterion Continuous Concentration (CCC), or the field-based selenium freshwater criterion.

New information concerning the toxicity of a particular substance (307.6(c)(9)(H))

An applicant or other interested party may provide new or updated information that indicates that the toxicity of a substance is significantly different from the numerical criteria in the TSWQS. This information will typically consist of additional or revised toxicity exposure testing. This testing should be conducted in accordance with "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" by the U.S. Environmental Protection Agency, Office of Research and Development (Stephan, et al).

Site-Specific Total Toxicity Standards

Additional chemical-specific or whole effluent toxicity limits may be established in a permit as a result of confirming whole effluent toxicity at the critical dilution. These chemical-specific or whole effluent toxicity limits may be adjusted based on site-specific factors discussed in the following paragraphs. However, any discharge limit(s) that fail to prevent significant toxicity to a test species at the designated critical dilution will require a demonstration that instream uses will not be impaired (30 TAC § 307.6(e)(2)(F)). An effluent limit that could exceed the Total Toxicity requirements of the TSWQS will require a site-specific amendment to the rule.

The remainder of this section discusses each factor to be considered in establishing permit limits and how the TNRCC staff will evaluate information submitted by an applicant.

Background toxicity of unimpacted receiving waters

Where background instream toxicity exists, the TNRCC may establish whole effluent or chemical-specific limits that will preclude an increase in the background receiving water toxicity. The applicant must demonstrate background toxicity by assessing toxicity in an area unimpacted by the discharge.

Persistence and degradation rate of principal toxic materials which are contributing to the total toxicity of the discharge

The applicant may demonstrate that chemicals responsible for toxicity in the effluent have a short half-life within the defined mixing zone of the receiving water due to chemical reactions with naturally occurring compounds, degradation in ultra-violet light, and so forth. This demonstration must be made using receiving water while simulating natural conditions as much as possible. The applicant may also use instream studies of existing discharges. The applicant must provide proof of chemical degradation and determine that receiving water total toxicity measurements do not violate appropriate criteria.

Site-specific variables which may alter the impact of toxicity in the discharge

An applicant may demonstrate that site-specific (receiving water specific) variables exist that alter the toxic impacts of an effluent. The applicant should use receiving water biological studies or should perform biomonitoring tests (at critical conditions) on receiving water samples collected immediately within the discharge plume to the end of the mixing zone.

Indigenous aquatic organisms, which may have different levels of tolerance than the species used for total toxicity testing

An applicant may demonstrate that indigenous aquatic organisms are not affected by the effluent at the same exposure concentration as the standard biomonitoring test species defined in the permit. This may be accomplished by performing a detailed survey of aquatic organisms in the water body in areas in and out of the effluent plume coupled with a statistical analysis of the data. In addition, the applicant should evaluate the relative sensitivities of indigenous organisms to particular toxicants of concern using literature information or effluent biomonitoring tests.

Technological, economic, or legal limits of treatability or control for specific toxic materials

If the permittee cannot achieve the required total toxicity or chemical-specific permit limits with best available technology (BAT), then the permittee may apply for a modification of the effluent limit. An applicant seeking an effluent limit modification because of the limitations of treatment technology, must demonstrate through the use of pilot tests, the level to which the specific toxic of concern can be treated using state-of-the-art treatment.

The permittee shall submit an evaluation of the costs of treatment required to meet the effluent limit and include a comparison of BAT or existing costs with estimated costs of state-of-the-art treatment. In this evaluation, the applicant should outline the incremental changes to the existing wastewater treatment facility to achieve state-of-the-art treatment. These changes might include alterations in raw materials, manufacturing processes, products produced, and energy requirements. Also, the applicant should demonstrate that improvements in best management practices such as source control, public education, housekeeping, a simple raw material substitution, or a water treatment chemical substitution would not achieve the treatment level required to meet the water-quality based effluent limits.

The applicant must show that existing or designated receiving water quality uses are not impaired due to the modified permit limits.

Table 1 - BACKGROUND CONCENTRATIONS

Segment <u>Number</u>	<u>Waterbody</u>		Total Copper <u>(ug/l)</u>	Total Lead <u>(ug/l)</u>	Total Silver <u>(ug/l)</u>	Total Zinc <u>(ug/l)</u>
1401	Colorado Estuary	0.99 ¹	0.27 ¹	0.003 ¹	1.76 ¹	
2412	Sabine Estuary	1.00 ¹	0.19 ¹	0.004 ¹	1.20 ¹	
2421	Galveston Estuary	0.75 ¹	0.21 ¹	0.004 ¹	1.90 ¹	
2439	Galveston Estuary	0.75 ¹	0.21 ¹	0.004 ¹	1.90 ¹	
2451	Lavaca-Matagorda Estuary	0.57 ¹	0.12 ¹	0.002 ¹	1.25 ¹	
2453	Lavaca-Matagorda Estuary	0.57 ¹	0.12 ¹	0.002 ¹	1.25 ¹	
2462	San Antonio Estuary	1.23 ¹	0.20 ¹	0.003 ¹	2.18 ¹	
2481	Corpus Christi Estuary	0.70 ¹	0.14 ¹	0.003 ¹	4.04 ¹	

Note: Micrograms/liter (ug/l) is equivalent to parts per billion (ppb).

Background concentrations represent the geometric mean of the data set.

¹ Data compiled from Benoit, G. and Santschi, P. H., 1991; Trace Metals in Texas Estuaries; Prepared for the Texas Chemical Council; Texas A&M University at Galveston, Department of Marine Science.

Table 2

AQUATIC LIFE SUBCATEGORIES

AQUATIC LIFE USE SUB- CATEGORY	DISSOLVED OXYGEN CRITERIA mg/l				AQUATIC LIFE ATTRIBUTES					
	Freshwater mean/min.	Freshwater in Spring mean/min.	Saltwater mean/min.		Habitat Characteristics	Species Assemblage	Sensitive Species	Diversity	Species Richness	Trophic Structure
Exceptional	6.0/4.0	6.0/5.0	5.0/4.0		Outstanding natural variability	Exceptional or unusual	Abundant	Exceptionally high	Exceptionally high	Balanced
High	5.0/3.0	5.5/4.5	4.0/3.0		Highly diverse	Usual association of regionally expected species	Present	High	High	Balanced to slightly imbalanced
Intermediate	4.0/3.0	5.0/4.0	3.0/2.0		Moderately diverse	Some expected species	Very low in abund- ance	Moderate	Moderate	Moderately imbalanced
Limited	3.0/2.0	4.0/3.0			Uniform	Most regionally expected species absent	Absent	Low	Low	Severely imbalanced

Table 3 - Critical low-flow values for dissolved oxygen for the eastern and southern Texas ecoregions as described in 30 TAC § 307.7(b)(3)(A)(ii).

Bedslope	6.0 DO	5.0 DO	4.0 DO	3.0 DO
(m/km)	(cfs)	(cfs)	(cfs)	(cfs)
0.1	*	18.3	3.0	0.5
0.2	*	7.7	1.3	0.2
0.3	28.6	4.7	0.8	0.1
0.4	20.0	3.3	0.5	0.1
0.5	15.2	2.5	0.4	0.1
0.6	12.1	2.0	0.3	0.1
0.7	10.0	1.6	0.3	0.0
0.8	8.4	1.4	0.2	0.0
0.9	7.3	1.2	0.2	0.0
1.0	6.4	1.0	0.2	0.0
1.1	5.7	0.9	0.2	0.0
1.2	5.1	0.8	0.1	0.0
1.3	4.6	0.8	0.1	0.0
1.4	4.2	0.7	0.1	0.0
1.5	3.9	0.6	0.1	0.0
1.6	3.6	0.6	0.1	0.0
1.7	3.3	0.5	0.1	0.0
1.8	3.1	0.5	0.1	0.0
2.1	2.5	0.4	0.1	0.0
2.4	2.2	0.4	0.1	0.0

* Flows are beyond the observed data used in the regression equation.

Dissolved oxygen criteria in this table are in mg/L and apply as 24-hour averages.

Dissolved oxygen criteria in this table apply at all stream flows at or above the indicated stream flow for each category.

Table 4

**LINEAR PARTITION COEFFICIENTS FOR PRIORITY METALS
IN STREAMS AND LAKES**

(Delos *et al*, 1984)

	STREAMS		LAKES	
METAL	Intercept (b)	Slope (m)	Intercept (b)	Slope (m)
Arsenic	5.68	-0.73	Assumed equal to streams	
Cadmium	6.60	-1.13	6.55	-0.92
Chromium	6.52	-0.93	6.34	-0.27
Copper	6.02	-0.74	6.45	-0.90
Lead	6.45	-0.80	6.31	-0.53
Mercury	6.46	-1.14	6.29	-1.17
Nickel	5.69	-0.57	6.34	-0.76
Silver*	6.38	-1.03	Assumed equal to streams	
Zinc	6.10	-0.70	6.52	-0.68

$$Kd = 10^b \times TSS^m$$

Kd = Linear Partition Coefficient
 TSS = Total Suspended Solids (mg/l)
 b = (intercept) found from table
 m = (slope) found from table

$$\frac{C}{C_T} = \frac{1}{1 + (Kd \times TSS \times 10^{-6})}$$

C/C_T = Fraction of Metal Dissolved

Example

Assume TSS = 10 mg/l in a river. Find Kd and C/C_T for Nickel.

$$Kd = (0.49 \times 10^6)(10^{-0.57}) = 0.13188 \times 10^6$$

$$C/C_T = 1 \div [1 + (0.13188 \times 10^6)(10)(10^{-6})] = 0.431$$

Delos, C.G., W.L. Richardson, J.V. DePinto, R.B. Ambrose, P.W. Rogers, K. Rygwelski, J.P. St. John, W.J. Shaughnessy, T.A. Faha, W.N. Christie, 1984. Technical Guidance Manual for Performing Waste Load Allocations. Book II: Streams and Rivers. Chapter 3: Toxic Substances, For the U.S. Environmental Protection Agency. (EPA-440/4-84-022).

*Texas Environmental Advisory Council, 1994.

Table 5

LINEAR PARTITION COEFFICIENTS FOR SOME PRIORITY METALS IN ESTUARINE SYSTEMS

(Benoit et al. *)

Metal	Intercept (b)	Slope (m)
Copper	4.85	-0.72
Lead	6.06	-0.85
Silver	5.86	-0.74
Zinc	5.36	-0.52

$$Kd = 10^b \times TSS^m$$

Kd = Partition coefficient
TSS = Total suspended solids (mg/l)
m = Slope (found from table)
b = Intercept (found from table)

$$\frac{C}{C_T} = \frac{1}{1 + (Kd \times TSS \times 10^{-6})}$$

C/C_T = Fraction of Metal Dissolved

Example

Assume TSS = 10 mg/l. Find Kd and C/C_T for Copper.

$$Kd = (0.07 \times 10^6)(10)^{-0.72} = 13,338.22$$

$$C/C_T = 1 \div [1 + (13,338.22 \times 10 \times 10^{-6})] = 0.88$$

*Benoit, G., S.D. Oktay-Marshall, A. Cantu II, E.M. Hood, C.H. Coleman, M.O. Corapcioglu, and P.H. Santschi. 1994. Partitioning of Cu, Pb, Ag, Zn, Fe, Al, and Mn Between Filter-Retaining Particles, Colloids, and Solution in Six Texas Estuaries. Marine Chemistry, 45: 307-336.

Table 6. Segment Specific Values for TSS, Total Hardness, and pH. Values are the (lower) 15th percentile and should be used in place of the basin values found in Table 2 of the TSWQS.

SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
0101	8	7.3	520
0102	2	7.9	200
0103	18	7.9	86
0104	2	7.6	190
0105	48	8.7	194
0201	26	7.2	46
0202	20	7.3	150
0203	3	7.5	46
0204	23	7.5	73
0205	30	7.5	430
0206	10	7.2	169
0207	11	7.1	1300
0208	5	6.7	46
0209	2	6.7	46
0210	4	7.3	46
0211	34	7.1	36
0212	3	7.8	46
0213	2	8.1	46
0214	19	7.4	360
0215	3	7.7	46
0216	5	7.4	630
0217	4	7.5	46
0218	11	7.4	270
0219	5	7.4	46

SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
0220	7	7.4	680
0221	6	7.4	354
0222	3	7.4	354
0223	2	7.7	46
0224	2	7.7	169
0225	12	6.4	169
0226	3	7.5	490
0227	5	7.4	169
0228	2	7.6	46
0229	11	7.6	294
0301	7	6.8	52
0302	5	6.5	52
0303	22	7.0	50
0304	5	6.5	52
0305	7	7.8	96
0306	19	7.3	52
0401	2	5.6	20
0402	1	5.8	10
0403	2	6.2	18
0404	8	6.6	32
0405	2	6.5	24
0406	4	6.1	14
0407	8	5.8	26
0408	1	6.4	46
0409	3	6.1	19

0501	6	6.5	20
SEGMENT NUMBER	TSS (mg/l)	pH (s.u)	HARDNESS (mg/l as CaCO ₃)
0503	8	6.2	28
0504	3	6.4	32
0505	14	6.3	38
0506	17	6.6	49
0507	4	7.0	71
0508	9	6.3	20
0509	3	6.7	41
0510	0	6.3	41
0511	8	6.6	20
0512	2	6.5	44
0513	4	5.9	29
0514	3	6.0	18
0515	4	6.8	49
0601	6	6.5	28
0602	15	6.4	24
0603	5	6.2	30
0604	12	6.4	32
0605	2	6.4	30
0606	8	6.5	32
0607	10	6.6	32
0608	5	5.3	12
0609	3	6.1	32
0610	3	6.3	30
0611	10	6.3	30

0612	8	6.2	32
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SEGMENT NUMBER	TSS (mg/l)	pH (s.u)	HARDNESS (mg/l as CaCO ₃)
0613	1	6.3	30
0614	1	6.2	30
0701	12	6.7	66
0702	10	6.8	66
0703	7	6.7	66
0704	12	6.7	84
0801	17	7.4	84
0802	8	7.2	28
0803	7	7.1	102
0804	33	6.6	110
0805	24	7.1	132
0806	10	7.3	140
0807	6	7.3	100
0808	6	7.4	72
0809	3	7.5	100
0810	13	7.4	72
0811	1	7.1	100
0812	28	6.9	72
0813	2	6.3	100
0814	12	7.4	72
0815	4	6.8	170
0816	2	6.8	100
0817	4	6.8	100
0818	7	6.9	100
0819	14	7.2	100

SEGMENT NUMBER	TSS (mg/l)	pH (s.u)	HARDNESS (mg/l as CaCO ₃)
0820	7	7.3	100
0821	5	7.6	100
0822	15	7.4	100
0823	12	7.1	23
0824	10	7.6	72
0825	13	7.0	72
0826	5	6.9	100
0827	8	6.8	100
0828	5	7.3	100
0829	5	7.4	72
0830	4	7.6	100
0831	6	7.4	72
0832	3	7.3	100
0833	10	7.1	72
0834	7	6.8	100
0835	7	7.2	93
0836	3	6.9	100
0837	7	7.2	72
0838	2	7.2	200
0839	8	7.6	72
0840	2	7.0	100
0841	10	7.0	140
0901	18	7.5	418
0902	4	7.1	50
1001	10	6.3	40

SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
1002	8	6.6	41
1003	9	6.3	32
1004	13	6.7	58
1005	12	7.6	632
1006	9	7.1	392
1007	7	7.0	100
1008	12	6.6	16
1009	14	6.9	34
1010	6	6.4	32
1011	4	5.9	118
1012	2	7.1	56
1013	11	7.1	47
1014	16	7.3	32
1015	10	6.4	42
1016	18	7.3	56
1017	13	7.3	33
1101	16	7.3	142
1102	18	6.8	133
1103	10	7.3	127
1104	12	7.1	157
1105	9	7.1	76
1107	12	7.7	1084
1108	10	7.0	157
1109	13	7.4	72
1110	10	7.3	92

SEGMENT NUMBER	TSS (mg/l)	pH (s.u)	HARDNESS (mg/l as CaCO ₃)
1111	5	7.8	2190
1113	17	7.7	161
1201	6	7.5	449
1202	14	7.1	150
1203	2	7.5	78
1204	4	7.6	220
1205	4	7.5	78
1206	5	7.7	189
1207	2	7.3	78
1208	26	7.5	240
1209	18	7.6	73
1210	12	7.6	78
1211	12	6.8	169
1212	10	7.2	97
1213	29	7.5	150
1214	13	7.3	170
1215	1	7.4	169
1216	2	7.5	78
1217	2	7.7	187
1218	4	7.2	169
1219	7	7.2	169
1220	2	7.3	78
1221	6	7.3	169
1222	7	7.6	78

SEGMENT NUMBER	TSS (mg/l)	pH (s.u)	HARDNESS (mg/l as CaCO ₃)
1223	3	7.8	178
1224	2	7.4	78
1225	5	7.4	78
1226	4	7.1	169
1227	4	7	169
1228	5	7.4	78
1229	4	7.5	169
1230	5	7.2	78
1231	5	7.6	78
1232	19	7.6	308
1233	3	7.7	210
1234	2	7.5	78
1235	12	7.8	78
1236	5	7.6	188
1237	5	7.5	78
1238	6	7.5	1200
1239	5	7.4	169
1240	3	7.9	78
1241	12	7.5	190
1242	7	7.6	150
1243	1	7.3	169
1244	5	7.2	169
1245	13	7.2	143
1246	5	7.3	169
1247	10	7.5	78

SEGMENT NUMBER	TSS (mg/l)	pH (s.u)	HARDNESS (mg/l as CaCO ₃)
1248	4	7.6	150
1249	5	7.4	78
1250	3	7.6	169
1251	1	7.7	170
1252	3	7.0	78
1253	12	7.2	65
1254	11	7.5	95
1301	8	7.3	68
1302	11	7.4	61
1304	12	7.3	124
1305	9	7.3	88
1401	10	7.5	8
1402	6	7.8	217
1403	1	7.6	246
1404	1	7.4	246
1405	2	7.6	246
1406	3	7.3	246
1407	2	7.5	246
1408	1	7.5	246
1409	17	7.7	200
1410	16	7.5	320
1411	5	7.5	246
1412	12	7.7	610
1413	7	7.7	246
1414	5	7.9	155

1415	4	7.9	140
SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
1416	5	7.7	232
1417	11	7.6	232
1418	5	7.3	246
1419	4	7.3	246
1420	10	7.1	232
1421	15	7.5	363
1422	9	7.8	246
1423	5	7.7	246
1424	5	7.2	232
1425	2	7.7	246
1426	14	7.8	190
1427	1	7.4	76
1428	4	7.3	96
1429	4	7.5	246
1430	3	7.4	70
1431	10	7.2	232
1432	4	7.5	232
1433	*	7.7	246
1501	12	7.4	100
1502	13	7.4	111
1601	10	7.4	135
1602	6	7.5	135
1603	8	7.6	135
1604	7	7.2	44

1605	5	7.5	88
1701	19	7.4	140
SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
1801	41	7.5	186
1803	17	7.8	180
1804	6	7.5	200
1805	2	7.4	186
1806	6	7.8	186
1807	5	7.4	186
1808	6	7.7	250
1809	2	7.5	186
1810	10	7.4	186
1811	1	7.0	186
1812	3	7.7	186
1813	1	7.5	186
1814	2	7.0	186
1815	1	7.2	186
1816	4	8.0	186
1817	*	7.7	186
1818	*	7.9	186
1901	37	7.6	86
1902	10	7.6	290
1903	9	7.5	260
1904	1	7.5	252
1905	1	7.8	242
1906	6	7.3	223

1907	1	7.2	242
1908	1	7.4	242
1909	2	7.7	242
SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
1910	6	7.3	49
1911	8	7.3	226
1912	8	7.5	242
1913	7	7.3	242
2001	10	7.5	250
2002	7	7.5	250
2003	14	7.7	250
2004	10	7.1	64
2101	32	7.9	250
2102	10	7.7	162
2103	7	7.9	167
2104	8	7.4	134
2105	10	7.5	152
2106	11	7.6	144
2107	9	7.5	112
2108	10	7.4	152
2109	15	7.5	152
2110	1	7.2	152
2111	1	7.6	152
2112	1	7.4	152
2113	1	7.8	152
2114	1	7.8	152

2115	1	7.5	104
2116	5	7.2	167
2117	9	7.6	142

SEGMENT NUMBER	TSS (mg/l)	pH (s.u)	HARDNESS (mg/l as CaCO ₃)
2201	11	7.6	306
2202	60	7.2	690
2203	20	7.9	306
2204	11	7.3	106
2301	19	7.7	250
2302	10	7.6	260
2303	5	7.9	250
2304	8	7.7	228
2305	2	7.8	250
2306	57	7.3	87
2307	101	7.1	285
2308	23	7.4	250
2309	1	7.4	151
2310	3	7.7	500
2311	5	7.5	1398
2312	6	7.5	250
2313	7	7.5	250
2314	23	7.8	250
2411	11	7.1	873
2412	5	6.8	873
2421	10	7.8	750
2422	7	7.8	152
2423	10	7.4	869
2424	9	7.8	3390
2425	14	7.7	398

2426	14	7.5	115
SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
2427	9	7.5	356
2428	20	7.7	873
2429	8	7.4	873
2430	8	7.4	873
2431	6	7.9	873
2432	8	7.5	2770
2433	4	7.8	873
2434	10	7.8	2950
2435	21	7.8	873
2436	8	7.6	873
2437	6	7.9	1000
2438	7	7.7	510
2439	8	7.9	1430
2441	19	7.8	873
2442	18	7.8	873
2451	10	7.9	873
2452	10	7.8	873
2453	9	7.5	180
2454	10	8.0	76
2455	10	8.0	873
2456	18	7.7	100
2461	10	8.0	873
2462	14	7.9	873
2463	12	7.8	873

2471	9	7.9	873
2472	12	7.6	873
SEGMENT NUMBER	TSS (mg/l)	pH (s.u.)	HARDNESS (mg/l as CaCO ₃)
2473	14	7.7	873
2481	11	7.9	4940
2482	17	7.8	873
2483	9	7.9	873
2484	10	7.8	5000
2485	35	7.6	52
2491	13	7.7	873
2492	19	7.8	306
2493	13	7.6	873
2494	14	7.7	5020
2501	8	6.7	873

Table 7. TNRCC Minimum Analytical Levels for Application Screening

Pollutant	CASRN*	MAL ug/l	Suggested Method
Aldrin	309-00-2	0.05	608
Alphahexachlorocyclohexane	319-84-6	0.05	608
Aluminum	7429-90-5	30	202.2
Arsenic	7440-38-2	10	206.2
Barium	7440-39-3	10	208.2
Benzene	71-43-2	10	624
Benzidine	92-87-5	50	625
Benzo [a] anthracene	56-55-3	10	625
Benzo [a] pyrene	50-32-8	10	625
Betahexachlorocyclohexane	319-85-7	0.05	608
Bis(chloromethyl)ether	542-88-1	**	**
Cadmium	7440-43-9	1	213.2
Carbon Tetrachloride	56-23-5	10	624
Carbaryl	63-25-2	5	632
Chlordane	57-74-9	0.15	608
Chlorobenzene	108-90-7	10	624
Chloroform	67-66-3	10	624
Chloropyrifos	2921-88-2	0.05	1657
Chromium	7440-47-3	10	218.2
Hexavalent Chromium	7440-47-3	10	218.4
Trivalent Chromium	7440-47-3	***	***
p-Chloro-m-Cresol	59-50-7	10	625
4,6-Dinitro-o-Cresol	534-52-1	50	625
p-Cresol	106-44-5	10	625

Table 7. TNRCC Minimum Analytical Levels for Application Screening (con't)

Pollutant	CASRN*	MAL ug/l	Suggested Method
Copper	7440-50-8	10	220.2
Chrysene	218-01-9	10	625
Total Cyanide	57-12-5	20	335.2
Cyanide, Amenable to Chlorination	57-12-5	20	335.1
Cyanide, Weak Acid Dissociable	57-12-5	20	4500-CN I.
4,4'-DDD	72-54-8	0.1	608
4,4'-DDE	72-55-9	0.1	608
4,4'-DDT	50-29-3	0.1	608
2,4-D	94-75-7	10	615
Danitol	39515-41-8	****	****
Demeton	8065-48-3	0.20	1657
Diazinon	333-41-5	0.5	1657
Dibromochloromethane	124-48-1	10	624
1,2-Dibromoethane	106-93-4	2	618
Dieldrin	60-57-1	0.1	608
1,4-Dichlorobenzene	106-46-7	10	625
1,2-Dichloroethane	107-06-2	10	624
1,1-Dichloroethylene	75-35-4	10	624
Dicofol	115-32-2	20	617

Table 7. TNRCC Minimum Analytical Levels for Application Screening (con't)

Pollutant	CASRN*	MAL ug/l	Suggested Method
Dioxins/Furans (TCDD Equivalents)			
2,3,7,8-TCDD	1746-01-6	10 ⁻⁵ or	1613
1,2,3,7,8-PeCDD	40321-76-4	ppq	
2,3,7,8-HxCDDs		50	
1,2,3,4,7,8-HxCDD	39227-28-6		
1,2,3,6,7,8-HxCDD	57653-85-7	50	
1,2,3,7,8,9-HxCDD	19408-74-3	50	
2,3,7,8-TCDF	51207-31-9	50	
1,2,3,7,8-PeCDF	57117-41-6	10	
2,3,4,7,8-PeCDF	57117-31-4	50	
2,3,7,8-HxCDFs		50	
1,2,3,4,7,8-HxCDF	70648-26-9		
1,2,3,6,7,8-HxCDF	57117-44-9	50	
1,2,3,7,8,9-HxCDF	72918-21-9	50	
2,3,4,6,7,8-HxCDF	60851-34-5	50	
Endosulfan I (Alpha)	115-29-7	0.1	608
Endosulfan II (Beta)	115-29-7	0.1	608
Endosulfan sulfate	1031-07-8	0.1	608
Endrin	72-20-8	0.1	608
Fluoride	16984488	500	340.3
Gammahexachlorocyclohexane (Lindane)	58-89-9	0.05	608
Guthion	86-50-0	0.1	1657
Heptachlor	76-44-8	0.05	608
Heptachlor Epoxide	1024-57-3	1.0	608
Hexachlorobenzene	118-74-1	10	625
Hexachlorobutadiene	87-68-3	10	625
Hexachloroethane	67-72-1	20	625
Hexachlorophene	70-30-4	10	604.1

Table 7. TNRCC Minimum Analytical Levels for Application Screening (con't)

Pollutant	CASRN*	MAL ug/l	Suggested Method
Lead	7439-92-1	5.0	239.2
Malathion	121-75-5	0.1	1657
Mercury	7439-97-6	0.2	245.1
Methoxychlor	72-43-5	2.0	617
Methyl Ethyl Ketone	78-93-3	50	624
Mirex	2385-85-5	0.2	617
Nitrate-Nitrogen	14797-55-8	1000	352.1
Nickel	7440-02-0	10	249.2
Nitrobenzene	98-95-3	10	625
N-Nitrosodiethylamine	55-18-5	20	625
N-Nitroso-di-n-Butylamine	924-16-3	20	625
Parathion	56-38-2	0.1	1657
Pentachlorobenzene	608-93-5	20	625
Pentachlorophenol	87-86-5	50	625
Phenanthrene	85-01-8	10	625
Polychlorinated Biphenyls (PCBs)			
PCB-1232	1336-36-3	1.0	608
PCB-1242	1336-36-3	1.0	
PCB-1254	1336-36-3	1.0	
PCB-1221	1336-36-3	1.0	
PCB-1248	1336-36-3	1.0	
PCB-1260	1336-36-3	1.0	
PCB-1016	1336-36-3	1.0	
Pyridine	110-86-1	20	625
Selenium	7782-49-2	10.0	270.2
Silver	7440-22-4	2.0	272.2

Table 7. TNRCC Minimum Analytical Levels for Application Screening (con't)

Pollutant	CASRN*	MAL ug/l	Suggested Method
1,2,4,5-Tetrachlorobenzene	95-94-3	20	625
Tetrachloroethylene	127-18-4	10	624
Toxaphene	8001-35-2	5.0	608
2,4,5-TP (Silvex)	93-72-1	2.0	615
Tributyltin	688-73-3	0.010	TNRCC 1001
2,4,5-Trichlorophenol	95-95-4	50	625
Trichloroethylene	79-01-6	10	624
1,1,1-Trichloroethane	71-55-6	10	624
TTHM (Total) Chloroform Bromoform Dichlorobromomethane Chlorodibromomethane	67-66-3 75-25-2 75-27-4 124-48-1	10 10 10 10	624
Vinyl Chloride	75-01-4	10	624
Zinc	7440-66-6	5.0	289.2

*Chemical Abstracts Service Registry Number

**Hydrolyzes in water. Will not require applicant to analyze at this time.

***Trivalent chromium (Cr) determined by subtracting hexavalent Cr from total Cr.

****EPA procedure not approved. Will not require applicant to analyze at this time.

TABLE 8. 1995 Analytical Methods for the Determination of Pollutants Regulated by 30 TAC, Chapter 307, Section 307.6

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
Aldrin	608	0.05	0.004	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.
Alpha-hexachlorocyclohexane	608	0.05	0.003	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.
Aluminum	202.2	30	7.8	MAL is approximately four times the detection limit for EPA 1991, Method 200.9*.
Arsenic	206.2	10	0.5	MAL is twenty times the detection limit documented in EPA 1991 Method 200.9* and corresponds to the Minimum Quantification Level (MQL) developed by EPA Region VI, July 1992.
Barium	208.2	10	2	MAL is the lowest concentration of the optimum working range given for EPA 1979, Method 208.2**
Benzene	624	10	4.4	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
Benzidine	625	50	50	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 625.
Benzo [a] anthracene	625	10	7.8	MAL based on the MQL developed by EPA, Region VI. July 1992. The MDL is documented in 40 CFR §136, Method 625.
Benzo [a] pyrene	625	10	2.5	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 625.
Beta-hexachlorocyclohexane	608	0.05	0.006	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
Bis(chloromethyl)ether	Undetermined Analytical Method			
Cadmium	213.2	1	0.05	MAL is twenty times the detection limit given for EPA 1991 Method 200.9* and corresponds to the MQL developed by EPA Region VI, July 1992.
Carbon Tetrachloride	624	10	2.8	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
Carbaryl	632	5.0	0.02	MAL is based on laboratory consensus taken October, 1992. MDL is given by EPA Method 632***.
Chlordane	608	0.15	0.014	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.
Chlorobenzene	624	10	6	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
Chloroform	624	10	1.6	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
Chloropyrifos	1657	0.05	0.004	MAL is approximately ten times the detection limit given by EPA Method 1657***.
Chromium Total Recoverable Dissolved	218.2	10.0	0.1	MAL is based on the Contract Required Detection Limit (CRDL) published in the EPA Contract Laboratory Program (CLP) Statement of Work, Doc.No. ILMO2.0, Method 218.2. MDL based on EPA 1991, Method 200.9*.
Hexavalent Chromium	218.4	10	1	MAL is ten times the detection limit given by EPA 1979, Method 218.4**.
Trivalent Chromium	See documentation note.			Trivalent chromium is determined by subtracting the concentration of hexavalent chromium (dissolved) from the dissolved total chromium concentration.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
p-Chloro-m-Cresol (4 chloro-3-methylphenol)	625	10	3	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 625.
4,6-Dinitro-o-Cresol (2 methyl 4,6-dinitrophenol)	625	50	24	MAL based on the MQL Developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 625.
p-Cresol (4-Methylphenol)	625	10	ND****	MAL based on the Contract Required Quantitation Limits (CRQL) for water from EPA, Region VI, Target Compound List acquired January 14, 1993.
Copper	220.2	10	0.7	MAL is approximately ten times the detection limit given by EPA 1991, Method 200.9*.
Chrysene	625	10	2.5	MAL based on the MQL developed by EPA, Region VI, July, 1992. The MDL is documented in 40 CFR §136, Method 625.
Cyanide (Total)	335.2	20	ND	MAL is based on the lowest standard concentration within the applicable range set in EPA 1979, Method 335.2**. The CRDL is 10 g/l published in the EPA Contract Laboratory Program Statement of Work, Document Number ILMO2.0 using Method 239.2.
Cyanide (Amenable to Chlorination)	335.1	20	ND	Both chlorinated and unchlorinated cyanide sample concentrations are determined using EPA 1979, Method 335.2**.
Cyanide (Weak Acid Dissociable)	4500-CN I.	20	1.4	MAL based on the MDL developed by the TNRCC Laboratory on 12/09/94.
DDD	608	0.1	0.011	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.
DDE	608	0.1	0.004	MAL based on the MQL Developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
DDT	608	0.1	0.012	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
2,4-D	615	10	1.2	MAL is approximately ten times the detection limit given by EPA Method 615***.
Danitol	Method Under Development	****	****	Method, MAL and MDL developed by the Texas Natural Resource Conservation Commission Laboratory. May be reviewed by EPA, Region VI for use in Texas.
Demeton	1657	0.20	0.020	MAL is ten times the detection limit given by EPA Method 1657***.
Diazinon	1657	0.5	0.038	MAL is approximately ten times the detection limit given by EPA Method 1657***.
Dibromochloromethane	624	10	3.1	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
1,2-Dibromoethane (Ethylenedibromide)	618	2	0.2	MAL is ten times the detection limit given in EPA Method 618***.
Dieldrin	608	0.1	0.002	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
1,4-Dichlorobenzene (p-Dichlorobenzene)	625	10	4.4	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 625.
1,2-Dichloroethane (Ethylenedichloride)	624	10	2.8	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
1,1-Dichloroethylene	624	10	2.8	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
Dicofol (Kelthane)	617	20	ND****	MAL based on laboratory consensus taken October, 1992 for and Method 617***.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
Dioxins/Furans (TCDD Equivalents) 2,3,7,8-TCDD 1,2,3,7,8-PeCDD 2,3,7,8-HxCDDs 1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD 2,3,7,8-TCDF 1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF 2,3,7,8-HxCDFs 1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF 2,3,4,6,7,8-HxCDF	1613	10 ppq 50 50 50 50 10 50 50 50 50 50 50	10 ppq	MAL based on the MQL developed by the Dioxin National Strategy as reported by EPA, Region VI, July 1992 Minimum Quantification Report and the minimum levels at which the analytical system will give acceptable selected ion current profile and calibration as published in EPA Method 1613.
Endosulfan I (Alpha)	608	0.1	0.014	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
Endosulfan II (Beta)	608	0.1	0.004	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
Endosulfan sulfate	608	0.1	0.066	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
Endrin	608	0.1	0.006	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
Fluoride	340.3	500	50	MAL is ten times the lowest concentration of the applicable working range given by EPA 1979, Method 340.3**.
Gamma-hexachlorocyclohexane (Lindane)	608	0.05	0.004	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
Guthion (Azinphos methyl)	1657	0.1	0.009	MAL is approximately ten times the detection limit given by EPA Method 1657***.
Heptachlor	608	0.05	0.003	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.
Heptachlor Epoxide	608	1.0	0.083	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 608.
Hexachlorobenzene	625	10	1.9	MAL based on the MQL developed by EPA, Region VI, July, 1992. The MDL is documented in 40 CFR §136, Method 625.
Hexachlorobutadiene	625	10	0.9	MAL is approximately ten times the detection limit documented in 40 CFR §136, Method 625 and corresponds to the MQL developed by EPA, Region VI, July, 1992.
Hexachloroethane	625	20	1.6	MAL based on the MQL developed by EPA, Region VI, July, 1992. The MDL is documented in 40 CFR §136, Method 625.
Hexachlorophene	604.1	10	1.2	MAL is approximately ten times the detection limit given in EPA Method 604.1***.
Lead	239.2	5.0	0.7	MAL is based on the MQL developed by EPA, Region VI, July, 1992 and is greater than the CRDL of 3 g/l published in the EPA Contract Laboratory Program Statement of Work, Doc. Number ILMO2.0 using Method 239.2. MDL based on EPA, 1991, Method 200.9*.
Malathion	1657	0.1	0.011	MAL is approximately ten times the detection limit given in EPA Method 1657***.
Mercury	245.1	0.2	ND****	MAL is based on the CRDL published in the EPA Contract Laboratory Program Statement of Work, Document Number ILMO2.0 using Method 245.1 and corresponds with the MQL developed by EPA, Region VI, July, 1992.
Methoxychlor	617	2.0	0.176	MAL is approximately ten times the detection limit given in EPA Method 617***.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
Methyl Ethyl Ketone	624	50	50	MAL is the minimum level at which the analytical system shall give acceptable calibration points documented in 40 CFR 136, Method 1624. MAL is five times the CRQL for water analysis using Method 624 from the EPA, Region VI, Target Compound List acquired January 14, 1993.
Mirex	617	0.2	0.015	MAL is approximately ten times the detection limit given in EPA Method 617***.
Nitrate-Nitrogen	352.1	1000	100	MAL is ten times the lowest concentration of the applicable range given by EPA 1979, Method 352.1**.
Nickel	249.2	10	0.6	MAL is approximately ten times the detection limit given for EPA 1991, Method 200.9*.
Nitrobenzene	625	10	1.9	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 625.
N-Nitrosodiethylamine	625	20	5	Method, MAL and MDL based on laboratory consensus taken October, 1992.
N-Nitroso-di-n-Butylamine	625	20	5	Method, MAL and MDL based on laboratory consensus taken October, 1992.
Parathion	1657	0.1	0.010	MAL is ten times the detection limit given in EPA Method 1657***.
Pentachlorobenzene	625	20	5	Method, MAL and MDL based on laboratory consensus taken October, 1992.
Pentachlorophenol	625	50	3.6	MAL based on the MQL developed by EPA, Region VI, July, 1992. MAL is based on the CRQL for water analysis using Method 625 from the EPA, Region VI, Target Compound List acquired January 14, 1993.
Phenanthrene	625	10	5.4	MAL based on the MQL developed by EPA, Region VI, July, 1992. The MDL is documented in 40 CFR §136, Method 625.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
Polychlorinated Biphenyls (PCBs) PCB-1232 PCB-1242 PCB-1254 PCB-1221 PCB-1248 PCB-1260 PCB-1016	608	1.0 1.0 1.0 1.0 1.0 1.0 1.0	ND**** 0.065 ND**** ND**** ND**** ND**** ND****	MAL based on the MQLs developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
Pyridine	625	20	5	Method, MAL and MDL based on laboratory consensus taken October, 1992.
Selenium	270.2	10.0	2.0	MAL is five times the detection limit for Method 270.2
Silver	272.2	2.0	0.5	MAL is based on the MQL developed by EPA Region VI, July, 1992. MDL based on EPA, 1991 Method 200.9*.
1,2,4,5-Tetrachlorobenzene	625	20	5	Method, MAL and MDL based on laboratory consensus taken October, 1992.
Tetrachloroethylene	624	10	4.1	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
Toxaphene	608	5.0	0.24	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 608.
2,4,5-TP (Silvex)	615	2.0	0.17	MAL is approximately ten times the detection limit given by EPA Method 615***.
Tributyltin	TNRCC 1001	0.010	3.2×10^{-6}	Method is entitled "Measurement of Butyltin Species in Water by n-Pentyl Derivatization with Gas Chromatography/Flame Photometric Detection (GC/FPD) and Gas Chromatography/Mass Spectrometry (GC/MS). MAL is equal to EPA tributyltin advisory level.

Pollutant	Suggested Method	MAL (ug/l)	MDL (ug/l)	Source Documentation
2,4,5-Trichlorophenol	625	50	10	MAL is five times the minimum level which the analytical system shall give acceptable calibration points documented in 40 CFR §136, Method 1625. MAL is based on the CRQL for water analysis using Method 625 from the EPA, Region VI, Target Compound List acquired January 14, 1993.
Trichloroethylene	624	10	1.9	MAL based on the MQL developed by EPA, Region VI, July 1992. The MDL is documented in 40 CFR §136, Method 624.
1,1,1-Trichloroethane	624	10	3.8	MAL based on the MQL developed by EPA, Region VI, July, 1992. The MDL is documented in 40 CFR §136, Method 624.
TTHM (Total Trihalomethanes) Chloroform Bromoform Dichlorobromomethane Chlorodibromomethane	624	10 10 10 10	1.6 4.7 2.2 3.1	MAL is based on the CRQL for water analysis using Method 624 from the EPA, Region VI, Target Compound List acquired January 14, 1993. Method detection limits are documented in 40 CFR §136, Method 624.
Vinyl Chloride	624	10	ND****	MAL based on the MQL developed by EPA, Region VI, July, 1992. The MDL is given as "nd" in 40 CFR §136, Method 624.
Zinc	289.2	5.0	0.3	MAL is approximately ten times the detection limit given by EPA 1991, Method 200.9*.

* "Methods for the Determination of Metals in Environmental Samples", Environmental Protection Agency, Environmental Monitoring Systems Laboratory-Cincinnati, EPA-600/4-91-010, June, 1991. Method 200.9 contains accuracy and precision data generated using graphite furnace atomic absorbance spectrophotometer techniques for the following metals: aluminum, arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver and zinc. This accuracy and precision data supports the working ranges and detection limits for each corresponding method found in 40 CFR Part 136.

** "Methods for the Chemical Analysis of Water and Wastes", Environmental Protection Agency, Environmental Monitoring Systems Laboratory-Cincinnati (EML-CI), EPA-600/4-79-020, Revised March 1983 and 1979 where applicable.

*** "EPA Methods for the Determination of Nonconventional Pesticides in Municipal and Industrial Wastewater", EPA-821-R-93-010-A & B,
August 1993.
**** ND = Not Determined